上海科技大学

ShanghaiTech University

信息科学与技术学院

开课课程手册

2019 年 10 月

目录

《计算机编程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS100
课程名称:	计算机编程	英文名称:	Introduction to Programming
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

The course provides an introduction to programming for starting undergraduate students. The course will be based on C and the object-oriented C++ programming languages, thus equipping attendees with powerful low-level languages for the efficient implementation of resource-hungry programs.

The following is a tentative list of covered topics:

On C:
C syntax, development environment
Flow Control, types, arrays, operations
Procedural abstraction, functions
Pointers
Basic algorithms (sorting etc.)
Input-output, debugging
Recursive programming
On C++:
Object-oriented programming
Basic data structures, the standard library
Polymorphism, templating, modularization
Multi-threading
Coding standards, coding patterns
CMake, Project management & documentation, profiling, debugging
R-value references, C++11, C++14, C++17
Exceptions
Introduction to Eigen, Ceres
Interfacing with Matlab and Python

Besides the lectures, the course will also involve a weekly recitation and coding homework assignments. The recitations

will be a mix of class material revision, introduction of some new related material, and in-class coding exercises. The homework assignments will involve implementations of certain functions and classes. Templates, interface definitions, and example test cases will be provided, and we will make use of an online compilation and testing system, thus streamlining the process towards a fair grading of the assignments. Development environment suggestions will be introduced at the beginning of the course, and the assignments will be introduced during the lectures as well as posted on the course webpage (along with test cases and deadlines).

三、教学内容、教学方式和学时安排

The course will contain around 32 lectures, 10 on C, 20 on C++, 1 summary lecture and 1 lecture for an exam. There will be only one exam, a late mid-term exam that will test the mastery of the two first thirds of the material. There will furthermore be 8 homeworks, 6 shorter ones which we aim to complete before the midterm exam, and 2 more elaborate ones after the midterm exam, testing the more advanced material of the course.

《线性系统 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE161
课程名称:	线性系统 I	英文名称:	Linear Systems I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Linear (dynamical) systems have found broad applications in control, signal processing, circuits, etc. This undergraduate course provides an introduction to linear systems, including applied linear algebra and description and analysis of linear systems.

三、教学内容、教学方式和学时安排

Applied linear algebra for systems: QR factorization, least-squares solutions, minimum-norm solutions, matrix exponential, Jordan canonical form, SVD, applications to linear systems, etc.

Description and analysis of linear systems: input-output description, state-space description, state-space solutions of linear dynamical systems, equivalence transformation, realization, input-output stability, internal stability, controllability, reachability, observability, etc.

《计算机视觉 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS172
课程名称:	计算机视觉 I	英文名称:	Computer Vision I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will introduce the basic concepts in computer vision, including the 3R's (reconstruction, registration and recognition), and some classical methods for solving computer vision tasks.

三、教学内容、教学方式和学时安排

I. Image formation

- Camera models
- Light and color
- Linear filters and edges
- Feature extraction (corners and blobs)

II. Recognition

- Bags of features

- Face detection and recognition

III. Grouping and fitting

- Hough transform
- RANSAC
- Alignment

IV. Geometric vision

- Camera calibration
- Epipolar geometry

《模拟集成电路 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE112
课程名称:	模拟集成电路 I	英文名称:	Analog Integrated Circuits
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will focus on analog VLSI circuit design and attempt to cover a wide range of circuit configurations that are useful for analog signal processing/computation beyond simple amplification and filtering.

三、教学内容、教学方式和学时安排

1. Review of pn-junction diodes, bipolar junction transistors, and MOSFETs (above and below
threshold operation)
2. Review of small signal analysis of simple transistor amplifiers, differential pairs, current mirrors
3. Common second-order effects: Miller-capacitance, Early effect, W/L ratio, short-channel
phenomenon.
4. Current-mode approaches: the translinear principle
5. Analysis of circuit variants: cascoding, active replacement elements

6. Feedback circuits, frequency response and compensation
7. Nonlinear circuits: peak/envelope detectors, rectifiers
8. Aggregate computations: normalization, winner-take-all, centroid
9. Floating-gates, hot-electron injection, tunneling
10. Basic noise analysis

《电路基础》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE111
课程名称:	电路基础	英文名称:	Electric Circuits
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程旨在讲授基础电路理论与原理，为今后学习电子与电气信息类相关专业课程准备必要的电路知识。

三、教学内容、教学方式和学时安排

本课程包括以下等内容：

1. 电路简介：电流与电压，功率与能量，电路元器件。
2. 直流电路
3. 基本电路定律：欧姆定律，基尔霍夫定律，分压与分流，星三角变换
4. 电路分析方法：节点电压法，网孔电流法
5. 电路定理：戴维南、诺顿等效电路，叠加定理
6. 运算放大器：理想运算放大器，同相、反相放大器，加法放大器，差分放大器
7. 电感，电容与互感
8. 拉普拉斯变换与傅里叶变换
9. 一阶与二阶电路
10. 交流电路
11. 正弦稳态电路分析与功率计算
12. 三相电路，磁耦合电路

13. 频率响应：传递函数，谐振，无源滤波器，有源滤波器。

《通信原理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE140
课程名称:	通信原理	英文名称:	Introduction to Communication Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This is an introduction course in communications that introduces the fundamentals of digital signaling, coding, digital transmission and reception. The goal is to equip the students with basic knowledge for design, analysis and comparison of digital communication systems and for the physical layer of data communication networks including wireless networks and the internet.

三、教学内容、教学方式和学时安排

Week Contents Notes
1 Review random processes and probabilities, etc. Chapter 1
2-3 Continuous-wave modulation Chapter 2
4-5 Digital modulation and baseband signal Chapters 3,4
6-7 Signal-space concept Chapter 5
8 Review and mid-term exam
9-10 Passband transmission and spread-spectrum communication Chapters 6,7
12-13 Introduction to information theory Chapter 9
14-15 Error-control coding Chapter 10
16 Review
17-18 Final exam

《电磁学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE130
课程名称:	电磁学	英文名称:	Electromagnetics
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

内容包括：静电场与静磁场，麦克斯韦方程组，电磁波，平面波，传输线理论，反射与透射，辐射与天线等。
使学生全面深入了解和掌握电磁学和传输线理论的基本概念和分析方法，为以后学习电磁、微波或者通信类的专业课以及从事与之有关的工程项目和科学研究打下坚实的理论基础。

三、教学内容、教学方式和学时安排

教学内容、教学方式和学时安排

课堂教学内容	**教学进度和学时安排**	**教学方式**
第一章 绪论 1.1 电磁的本质 1.2 行波 1.3 电磁波谱 1.4 复数和相量的复习	4 学时	课堂教学、课后复习（作业）、讨论课、小测验
第二章 矢量分析 2.1 矢量运算基本定理的复习 2.2 梯度、散度和旋度的复习	3 学时	课堂教学、课后复习（作业）、讨论课、小测验
第三章 静电场和静磁场 3.1 静电场的复习	6 学时	课堂教学、课后复习（作业）、讨论课、小测验

3.2 电边界条件 3.3 静磁场的复习 3.4 材料的磁性 3.5 磁边界条件		
第四章 麦克斯韦方程组和时变电磁场 4.1 法拉第定律 4.2 法拉第定律的一些应用 4.3 位移电流 4.4 电磁边界条件 4.5 电荷电流连续关系 4.6 电磁势函数	7 学时	课堂教学、课后复习（作业）、讨论课、小测验
第五章 平面波传播 5.1 时谐场 5.2 平面波在无损材料中的传播 5.3 波的极化 5.4 平面波在有损材料中的传播 5.5 良好导体中的电流 5.6 电磁波的功率密度	8 学时	课堂教学、课后复习（作业）、讨论课、小测验
期中考试	3 小时	闭卷，可以带两张写有公式的纸
第六章 反射，透射与波导 6.1 垂直入射的反射和透射 6.2 斯奈尔定律 6.3 斜入射的反射与透射	12 学时	课堂教学、课后复习（作业）、讨论课、小测验

6.4 光纤 6.5 波导 6.6 矩形波导中的模式和参数 6.7 谐振腔		
第七章 传输线 7.1 导论 7.2 集总元件模型 7.3 传输线方程 7.4 波在传输线上的传播 7.5 无损传输线 7.6 传输线的输入阻抗 7.7 特殊的传输线 7.8 传输线上的功率流 7.9 史密斯圆图 7.10 阻抗匹配	12 学时	课堂教学、课后复习（作业）、讨论课、小测验
第八章 辐射与天线 8.1 赫兹偶极子天线 8.2 天线辐射特性及参数 8.3 半波长偶极子天线 8.4 任意长度偶极子天线 8.5 接收天线有效区域 8.6 传播公式 8.7 开口天线的辐射 8.8 天线阵和相控阵	10 学时	课堂教学、课后复习（作业）、讨论课、小测验

期末复习	2 学时	复习、讨论
期末考试	3 小时	闭卷，可以带三张写有公式的纸

实验和课程设计内容

编号	内容	简要说明	主要实验仪器
实验一	示波器和频谱分析仪的使用	用示波器和频谱分析仪测量简单信号的波形及频谱	信号发生器、示波器、频谱分析仪
实验二	液体的宽带介电常数和电导率的测量	借助专业的探头测量不同液体的宽带介电常数和电导率	矢量网络分析仪、专业测量探头
实验三	极化天线的传输与接收	利用不同极化的天线发射和接收电磁波，测量极化波的传输效率	矢量网络分析仪、单极化圆极化天线若干
实验四	矩形波导仿真	学习使用专业电磁场仿真软件 CST，并仿真矩形波导，观察波导中不同模式的传播及场的分布	CST 软件
实验五	传输线上的反射测量	观察并测量传输线接不同负载的反射系数	示波器、同轴传输线、微带传输线、负载若干
实验六	阻抗匹配设计	学习使用专业微波电路仿真软件 ADS，并设计若干个阻抗匹配器	ADS 软件
实验七	偶极子天线仿真	使用 CST 软件仿真若干偶极子天线，并分析天线的参数	CST 软件
课程设计	天线设计与制作	设计一个贴片天线并测量相关参数	CST 软件、矢量网络分析仪

专业课程设计 （延长到暑期小学期完成）

编号	内容	简要说明	主要实验仪器

题目一	相控阵天线	设计制作一个简单的相控阵天线和其控制电路，并测量相关参数	CST 软件、矢量网络分析仪、电路板、微波连接器、移相器、微波同轴负载、同轴线等
题目二	雷达测量	利用雷达测量物体的运动轨迹，编写算法识别不同种类的物体，设计频率选择表面与雷达配合使用	微波雷达系统、多种被测物体、CST 软件、矢量网络分析仪、微波天线
题目三	微波成像	设计微波天线，利用微波天线对物体成像，设计成像算法	CST 软件、矢量网络分析仪、机械移动平台、电路板、金属被测物体等

《信号与系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE150
课程名称:	信号与系统	英文名称:	Signals and Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Introduction: This course covers important methods of modern s ignal and system analysis, especially the linear time-invarian t systems and Fourier analysis.

Objectives: Understand the concepts and techniques, and apply them in new systems.

三、教学内容、教学方式和学时安排

Course contents: Linear time-invariant systems, Fourier series, continuous-ti me Fourier transform, discrete-time Fourier transform, time and frequeny cha racterization, Laplace transform, and Z transform.

Teaching: Class teaching.

Schedule:

Signals and systems	Three weeks	Lecture
linear time-invariant systems	Two weeks	Lecture
Fourier series	Two weeks	Lecture
Continuous-time Fourier transform	Two weeks	Lecture
Discrete-time Fourier transform	Two weeks	Lecture
Sampling	One week	Lecture
Laplace transform	Two weeks	Lecture
Z transform	Two weeks	Lecture

《操作系统 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS130
课程名称:	操作系统 I	英文名称:	Operating Systems I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

操作系统作为计算机科学专业的核心基础课程，主要讲授操作系统的概念与设计。该课程主要包括操作系统概念、系统编程、分布式系统以及存储系统几大主题，涵盖多处理器系统（进程、进程间通信、同步）、内存分配（分段、分页）、资源分配与调度、文件系统、网络基本概念（sockets、网络分层、API、网络可靠性）、安全性以及隐私等主题。

顺利完成本课程的同学应该具有以下基本能力：

1. 了解操作系统的特征
2. 掌握操作系统的基本原理与基本概念
3. 在理解掌握基本概念的基础上掌握操作系统的主要管理技术
4. 能够使用所学知识，在实际操作系统平台上开展功能设计、调试及实现

三、教学内容、教学方式和学时安排

课堂教学内容	教学进度和学时安排	教学方式
课程介绍	第 1 周 a 2 学时	课堂教学
课程导论	第 1 周 b 2 学时	课堂教学
进程 1	第 2 周 a 2 学时	课堂教学
	第 2 周 b 2 学时	课堂教学
进程 2	第 3 周 a 2 学时	课堂教学
	第 3 周 b 2 学时	课堂教学
并发	第 4 周 a 2 学时	课堂教学
	第 4 周 b 2 学时	课堂教学
同步 1	第 5 周 a 2 学时	课堂教学
	第 5 周 b 2 学时	课堂教学
同步 2	第 6 周 a 2 学时	课堂教学
	第 6 周 b 2 学时	课堂教学
内存 1	第 7 周 a 2 学时	课堂教学

	第 7 周 b 2 学时	课堂教学
期中考试	第 8 周 a 2 学时	开卷
内存 2	第 8 周 b 2 学时	课堂教学
	第 9 周 a 2 学时	课堂教学
缓存 1	第 9 周 b 2 学时	课堂教学
	第 10 周 a 2 学时	课堂教学
期中考试试卷分析	第 10 周 b 2 学时	试卷分析
缓存 2	第 11 周 a 2 学时	课堂教学
	第 11 周 b 2 学时	课堂教学
存储系统	第 12 周 a 2 学时	课堂教学
	第 12 周 b 2 学时	课堂教学
期末考试	第 18 周	闭卷

《数据库与数据挖掘》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS150
课程名称:	数据库与数据挖掘	英文名称:	Database and Data Mining

学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers database design and the use of databases in applications, with an introduction to the internals of relational database engines as well as basic data mining methods.

The main content of this course includes the following topics:
- Relational data model, relational algebra, and SQL.
- Database design and relational design principles based on dependencies and normal forms.
- Database services including protection, integrity control, and alternative views of data.
- Query optimization and introduction to transaction processing.
- Modern database systems, including Parallel Databases, NoSQL, Hadoop and Spark for large-scale data processing.
- The integration between data mining, machine learning and database technology.

三、教学内容、教学方式和学时安排

- Discussion sessions: Once every week with quiz, which is mandatory
- Assignments are typically due before class, typically 2 weeks to complete

Content	Schedule	Details
Introduction to DMS	Week 1 2h	
SQL I	Week 1 2h	Homework 1
SQL II	Week 2 2h	
SQL III	Week 2 2h	
Entity/Relation Model	Week 3 2h	
Database Design I	Week 3 2h	HW1 due
Database Design II	Week 4 2h	Homework2
Transactions I	Week 4 2h	

Transactions II	Week 5 2h	
IO model	Week 5 2h	
External algorithm	Week 6 2h	HW2 due
File & IO	Week 6 2h	Homework 3
File & indexes	Week 7 2h	
Relation operators	Week 7 2h	
Midterm review	Week 8 2h	
Midterm	Week 8 2h	HW3 due
Relational Algebra	Week 9 2h	
Query Optimization	Week 9 2h	
Cloud computing	Week 10 2h	
Analytics and ML I	Week 10 2h	Homework 4
Analytics and ML II	Week 11 2h	
Analytics and ML III	Week 11 2h	
Analytics and ML IV	Week12 2h	
Analytics and ML V	Week12 2h	HW4 due
Analytics and ML VI	Week13 2h	Project
Analytics and ML VII	Week13 2h	
Analytics and ML VIII	Week14 2h	
NoSQL I	Week14 2h	
NoSQL II	Week15 2h	Project Due
NoSQL III	Week15 2h	
Guest Lecture on Big Data	Week16 2h	Tentative
Final Exam	Week16 2h	Closed-book

《信息科学技术导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100B

课程名称:	信息科学技术导论	英文名称:	Introduction to Information Science and Technology
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This introductory information science course is offered to non-major undergraduate students.
This course consists of three components.
Programming. Students are expected to learn basics in Python programming language as computational methods in order to be successful in science, engineering, business, and other professions. The students will learn: 1. How to set up the environment to run and develop python programs; 2. Python coding primitives, including variables, built-in data types and syntax; 3. Coding in Python, including flow control, functions, file handling, packages and guidance on coding style. Students will also get some exposure to data science and its applications using Python.
Seminar. This part gives around 15 seminars within the information science.
Lab. With this part the student will experience: 1. How to produce, think, and generalize a creative electric-like idea; 2. The preliminary introduction about electronic components; 3. Building an Electronic function Module by hand.

三、教学内容、教学方式和学时安排

Programming. 13 lectures. Tentative arrangement as follows:
Lecture 1-2, setting up the environment to run and develop python programs;
Lecture 3-4, getting familiar with python coding primitives, including variables, built-in data types and syntax;
Lecture 5-11, coding in Python, including flow control, functions, file handling, packages and guidance on coding style. With one midterm exam during this period.
Lecture 12-13, some introduction to data science and its applications with Python.

Seminar. Around 15 lectures.
Lab. 2 lectures.

《嵌入式系统课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE114P
课程名称:	嵌入式系统课程设计	英文名称:	Introduction to Embedded Systems Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程旨在通过综合性的软硬件设计以及动手实践项目，加深学生对 EE 专业涉及知识的全面理解和融会贯通，同时提升其在工程实践上的综合素质与实战能力。

三、教学内容、教学方式和学时安排

教学内容：
在该课程设计中，同学们以三人一组完成项目：

1. 旋转实验系统。在该课题中给予同学们一个完整的旋转实验系统，包括：自激震荡电路、电机控制、旋转 LED 显示，涉及《电路基础》、《模拟与数字电路》、《电机及控制》、《单片机结构及设计》，经过该项目的训练，对 EE 专业的基础知识做一次梳理和归纳；嵌入式平台：51 单片机。

2. 从自动控制拓展到人工智能，第二个项目为两位数电位器读数识别，要求学生基于 labview Myrio 编写一个自动控制程序，以此得到一个用于人工智能训练的数据集，然后在 Baidu AIstudio 平台训练读数识别模型。编程语言：labview 和 Python；嵌入式平台： NI myRIO；人工智能训练平台：Baidu AI studio。涉及内容：（1）直流电机的结构及控制原理；（2）自动控制原理，PID 算法；（3）采用摄像头采

集图像并对图像进行处理；（4）用自动化的方式建立识别数值的人工智能数据集，并在 baidu AI studio 平台训练。要求：（1）嵌入式基础，优选具有 labview 的嵌入式编程经验；（2）自动控制原理，熟悉 PID 算法；（3）对 python 深度学习有一定基础。

教学方式：
课程设计以学生主导，指导老师与助教定期检查项目进度，并从相关方向提供方案指导与技术建议。
学时安排：
无具体学时安排，建议每人每周不少于 25 小时学习工作时间。

《电力电子变换器建模与控制》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE270
课程名称:	电力电子变换器建模与控制	英文名称:	Power Electronic Converters Modeling and Control
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程为开关电源的导论课。第一部分主要讲基本的变转换器的工作原理，主要包括变换器的稳态建模和分析，开关的实现，断续导通模式，隔离变换器等。第二部分主要讨论变换器的控制系统，主要包括变换器的交流平均信号建模，小信号传递函数，以及典型的反馈环路设计。第三部分主要讨论电流模式控制，包括大占空比的查恩党，简单的一阶模型，和精准建模方法。

三、教学内容、教学方式和学时安排

1. 导论
2. 稳态分析基本原理
3. 稳态等效电路建模，损耗，效率
4. 开关实现
5. 断续导通模式

6. 变换器拓扑电路
7. 交流等效电路建模
8. 变换器的传递函数
9. 控制器设计
10. 电流模式控制
11. 前沿课题研讨

《线性系统 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE261
课程名称:	线性系统 II	英文名称:	Linear Systems II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course provides fundamental theories and tools in linear systems and control. It includes mathematical descriptions, analysis, and design (i.e., control) of linear dynamical systems. The course is appropriate for graduate students who are interested in control systems, dynamical systems, signal processing, circuit analysis, etc.

三、教学内容、教学方式和学时安排

Input-output and state-space descriptions of linear systems

State-space solutions

Equivalence transformation

Realizations and canonical forms

Input-output and internal stability

Lyapunov stability theorem and LaSalle's Invariance Principle

Controllability, stabilizability, observability, and delectability

State feedback and state estimator

Tracking and disturbance rejection

Linear quadratic control and Kalman filter

《微纳加工与微机电系统基础》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE124
课程名称:	微纳加工与微机电系统基础	英文名称:	Introduction to Micro/Nano-machining and MEMS
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Fundamental of Semiconductor Micro-/Nano-machining process and Micro-Electro-Mechanical System (MEMS), including photolithography, deposition, etching, releasing, CMOS process, electrostatic and piezoelectric transducers.

三、教学内容、教学方式和学时安排

Lecture	Topic
1	Introduction part 1
2	Introduction part 2
3	Scaling
4	Process Flow and Crystallography
5	Chemical Safety and Cleaning Procedures
6	Mask Making and Layout
7	Photolithography Basics
8	Photolithographic Tools
9	Wet Etching

10	Vacuum Systems
11	Dry Etching
12	Physical Vapor Deposition
13	Diffusion
14	Ion Implantation
15	Oxidation
16	Chemical Vapor Deposition
17	Atomic Layer Deposition
18	Fabrication of MOSFET
19	Fabrication of Microchannels
20	Mechanics of Materials and Structures
21	Electrostatic Transduction
22	Piezoelectric Transduction
23	Process Integration
24	MEMS Examples
25	Cleanroom Fab
26	Project & Presentation
	Homework/Lab/Project assignments will be adjusted/distributed according to the resources and student background

《微波工程 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE230
课程名称:	微波工程 I	英文名称:	Microwave Engineering I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

这门课程旨在让研究生掌握基本的微波无源电路的概念、分析方法和设计方法。学生将能够设计，分析，测量一些典型的无源微波电路，并且了解微波工程领域中一些更前沿的内容。无源微波电路在众多领域中有着广泛的应用，例如天线，通信系统，手机，无线网络，雷达，导航系统，遥感，武器系统，和生物医学仪器等。

三、教学内容、教学方式和学时安排

课堂教学内容	教学进度和学时安排	教学方式
基础电磁学理论，包括麦克斯韦方程组，边界条件，波动方程，能量和功率，波的反射	6 学时	课堂教学、课堂测验、文献阅读、讨论
传输线理论，包括传输线的模型与场分析，史密斯圆图，四分之一波长变换器	6 学时	课堂教学、课堂测验、文献阅读、讨论
阻抗匹配，包括集总原件匹配，支节调配法，多段匹配法	4 学时	课堂教学、课堂测验、文献阅读、讨论
波导和传输线，包括平行板波导，矩形波导，圆型波导，波导的激励，同轴线，微带线，波速和色散	8 学时	课堂教学、课堂测验、文献阅读、讨论
微波网络分析，包括阻抗和导纳矩阵，散射矩阵，传输矩阵	8 学时	课堂教学、课堂测验、文献阅读、讨论
微波谐振器，包括谐振电路，传输线谐振器，矩形腔体谐振器，圆形腔体谐振器，介质谐振器，谐振器的激励	8 学时	课堂教学、课堂测验、文献阅读、讨论
功分器和定向耦合器，包括基本性质，T 功分器，威尔金森功分器，90°和 180°合路器	8 学时	课堂教学、课堂测验、文献阅读、讨论
期末考试	180 分钟	闭卷

《无损检测与传感器技术选论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE236H

课程名称:	无损检测与传感器技术选论	英文名称:	Nondestructive Testing and Sensing Technology Selection
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

主要讲授无损检测技术的基本原理、方法与应用，包括常见的无损检测系统介绍；无损检测系统特性分析；信号获取的原理与方法，传感器的作用原理、关联电路及应用；信号的调理与转换；显示记录技术及仪器等。

三、教学内容、教学方式和学时安排

教学内容：

1）无损检测概论 （2 课时）

无损检测技术的基本原理、方法与应用。

2）传感器技术与仪器概论 （4 课时）

常用的传感器介绍，测量信号的获取与分析方法，信号调理与处理方法，测量系统的抗干扰技术。

3）专题选介

漏磁检测（2 课时），涡流检测（6 课时），阻抗检测及成像（2 课时），微波检测（2 课时），红外成像（4 课时），光学检测（2 课时），超声检测（4 课时），X 射线检测（2 课时），微纳米测量与测试（2 课时），复合材料检测（2 课时）。

4）缺陷识别与量化（6 课时）

5）课堂讨论（4 课时）

6）案例分析（4 课时）

采用课堂教学，课堂讨论、案例分析相结合的教学方式。

《信号检测和估计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE251
课程名称:	信号检测和估计	英文名称:	Signal Detection and Estimation
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course serves as one fundamental course for you to study those advanced topics including communication, signal processing, and machine learning. In this course, we will learn the fundamental principles of optimal detection and estimation, including both classical and Bayesian approaches. This course contains two main parts. Part I will introduce the estimation theory where both linear and non-linear estimators will be discussed. Kalman filters addressing the optimal estimation in the case of dynamic environments will also be touched in details. In part II, we will review the detection theory starting from the Neyman-Pearson detection to the minimum Bayes risk detectors. Then composite hypothesis testing will be discussed and GLRT will be introduced. Further, some main applications in statistical learning will also be reviewed.

三、教学内容、教学方式和学时安排

Week	Content	Lecture 1	Lecture 2
1	Introduction to MVUE	2 hours	2 hours
2	Cramer-Rao Lower Bound	2 hours	2 hours
3	Neyman-Fisher Factorization, RBLS Theorem	2 hours	2 hours
4		2 hours	2 hours
5	Best Linear Unbiased Estimator	2 hours	2 hours
6	Maximum Likelihood Estimator	2 hours	2 hours

7	Bayesian Estimator, Kalman Estimator	2 hours	2 hours
8	Kalman Estimator + [Mid-term Exam]	2 hours	2 hours
9		2 hours	2 hours
10	Introduction to Detector, Neyman-Pearson Detection	2 hours	2 hours
11	Minimax Test, Receiver Operation Characteristic Curve	2 hours	2 hours
12		2 hours	2 hours
13	M-ary Hypothesis Testing, Asymptotic Performance of LRT	2 hours	2 hours
14	Sequential Tests, Composite Hypothesis Testing	2 hours	2 hours
15	Karhunen-Loeve Decomposition	2 hours	2 hours
16	Misc. Topics in Statistical Learning	2 hours	2 hours

《数字信号处理 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE250H
课程名称:	数字信号处理 II	英文名称:	Digital Signal Processing II
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

1．课程简介

本课程首先介绍离散和数字信号处理（DSP）的基本概念，然后分别从时域离散信号与时域离散系统，连续时间信号的采样，线性时不变系统的变换分析，离散时间系统结构，FIR 和 IR 滤波器的设计，离散傅立叶变换（DFT），快速傅立叶变换（FFT）等方面进行了阐述，最后介绍了数字信号系统的分析法。

建议本课程作为电子工程、信息工程、通信工程、信息处理、图像处理、自动控制等专业的必修学科基础课程。

建议本课程安排为 24 次课，每周上 2 次课，每次授课 2 学时，共 48 学时。

2．教学目的

数字信号处理是利用计算机或专用处理设备，以数值计算的方法对信号进行采集、变换、综合、估值与识别等分析和处理，借以达到提取信息和便于应用的目的。数字信号处理技术广泛应用于通信、电子、图像处理、信息处理、自动化控制、物联网等行业。通过本课程的学

习，学生能够全面掌握离散时间信号和系统的基本理论和数字信号处理技术，并了解数字信号处理技术在通信系统中的应用，熟悉基于 Matlab 软件的离散时间信号和系统及数字信号处理算法的仿真与验证方法，为学生今后能应用 DSP 技术解决实际工作中的问题打下良好的理论和实践基础。

三、教学内容、教学方式和学时安排

教学内容	学时安排	教学方式
1．数字信号处理概述	1	课堂讲授
2．离散时间信号和系统	4	课堂讲授
3．Matlab 与作业讲解	1	课堂讲授
4. z 变换	3	课堂讲授
5．连续时间信号的采样	5	课堂讲授
6. Matlab 与作业讲解	1	课堂讲授
7．线性时不变系统的变换分析	5	课堂讲授
8．离散时间系统结构	5	课堂讲授
9. Matlab 与作业讲解	1	课堂讲授
10．滤波器设计方法	6	课堂讲授
11．离散傅立叶变换	4	课堂讲授
12．Matlab 与作业讲解	1	课堂讲授
13．离散傅立叶变换的计算	3	课堂讲授
14．利用离散傅立叶变换的信号傅立叶分析	5	课堂讲授
15．Matlab 与作业讲解	1	课堂讲授
16.课程复习与考试解答	2	课堂讲授

《算法设计与分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS240
课程名称:	算法设计与分析	英文名称:	Algorithm Design and Analysis
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers advanced algorithm design and analysis techniques. Specific topics to be covered include: basics of algorithm analysis, graph algorithms, greedy algorithms, divide and conquer, dynamic programming, network flow, computational complexity classes, approximation algorithms, randomized algorithms.

三、教学内容、教学方式和学时安排

Week 1: basics of algorithms analysis, graph algorithms

Week 2: greedy algorithms

Week 3: divide and conquer

Week 4: dynamic programming

Week 5-6: network flow

Week 7-9: computational complexity classes

Week 10: extending the limits of tractibility

Week 11: approximation algorithms

Week 12: randomized algorithms

《机器人》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS283
课程名称:	机器人	英文名称:	Robotics
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course provides an introduction into robotics. It is open to all graduate students and 3rd and 4th year undergraduate students. It covers topics like applications of robotics, software design, locomotion, sensing, localization, motion planning and autonomy for mobile robots as well as a short introduction to planning for robotic arms. Homeworks will include small software components written in C++ using ROS (http://www.ros.org).

Students will select a paper from a Robotics conference, read and understand it and then give a short presentation about it.

A significant part of the course will be a project. It will include a project proposal (with state of the art) and the design and implementation of a software component. This software should interact with actual robot hardware - pure software projects should be the exception. Experiments will be performed with this component and the findings are presented in a final report, a second presentation and a website. Depending on the class size, the project and all its related aspects might be done in small groups (up to three students).

Please check out https://robotics.shanghaitech.edu.cn/teaching for the webpages of the previous courses for more detailed information (and last year's project websites!).

三、教学内容、教学方式和学时安排

The schedule is subject to change.

	Topic	HW/Project	Other
Week 1	Intro		
Week 2	Software/Kinematics	HW 1	
Week 3	Sensors	HW 2	
Week 4	Perception	HW 3	
Week 5	Locatlization	HW 4	
Week 6			Presentations
Week 7	ICP/Project	Project 1.1	
Week 8	SLAM/Project		
Week 9	Navigation/Project		
Week 10	Planning/Project		
Week 11	Autonomy/Project		
Week 12	Summary/Project	Project 1.2	
Week 13	Project		
Week 14	Project		
Week 15	Project		
Week 16	Project	Project	Presentations
			Final

《微机电系统原理与设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE224
课程名称:	微机电系统原理与设计	英文名称:	MEMS Physics & Design
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will cover the all aspects of micro-electromechanical systems (MEMS) from transduction physics, fabrication process and design optimization.
You will learn the most comprehensive course in SIST through one intensive semester. Several transduction mechanisms will be introduced, including electrostatic, piezoresistive, piezoelectric, magnetic, thermal and microfluidics, as well as their application and p

rocess integration. Multiple software tools, such as L-EDIT, ADS, MATLAB, SOLIDWORKS, COMSOL and COVENTORWARE will be utilized and exercised in depth for MEMS transducer design projects.

三、教学内容、教学方式和学时安排

Lecture	Topic
1	Introduction to MEMS
2	Introduction to Electronics
3	Mechanics of Materials
4	Electrostatic Sensors and Actuators I
5	Holiday
6	Holiday
7	Electrostatic Sensors and Actuators II
8	COMSOL, L-Edit and MEMS Related Software
9	RF MEMS I
10	RF MEMS II
11	Lumped Element Modeling
12	Energy Conserving Transducers
13	Magnetic Transduction
14	Dynamics
15	Piezoelectric Transduction
16	Electrostatic Resonators
17	Invited Talk/Quiz
18	Project I Review
19	Piezoelectric Resonators I
20	Piezoelectric Resonators II
21	MEMS Software Lab
22	Thermal Transduction
23	Piezoresistive Transduction
24	Microfluidics
25	Surface Micromachining
26	Bulk Micromachining
27	Process Integration
28	Project II Review
29	MEMS Packaging
30	MEMS Examples I
31	MEMS Examples II
32	Final Presentation
	Homework/Lab/Project assignments will be adjusted/distributed according to the resources and student background

《网络和文本挖掘》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS190B
课程名称:	网络和文本挖掘	英文名称:	Web and Text Mining
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces the concepts and applications of web and text mining. Web mining aims to discover useful knowledge from Web hyperlinks, page content and usage log. Text mining deals with unstructured textual information and aims to discover hidden patterns for better decision making. In the age of Web 2.0, the two techniques are often integrated in mining social media content and web pages. This course will cover the following related topics: web structure mining, web content mining, web usage mining, web crawling, search engine, lexical analysis, POS analysis, text classification and clustering, and sentiment analysis.

The emphasize of the course is to design and develop a solution based on web and text mining techniques for a real business problem. The course is a combination of lectures, labs and projects. Theories and examples will be introduced during lecture sessions. Students will practice hands-on programming with Python in labs. Finally, students are required to solve a real-world problem using web and text mining approach in project sessions. Students will form groups and give a brief class presentation on the project during the last week of class.

三、教学内容、教学方式和学时安排

Session		Note
1	Introduction to Web and Text mining --What can be mined from the Web? (content, structure, usage)	Lecture

	-- Differences between web mining, text mining and data mining Web content analysis -- unstructured and structured content mining, text mining -- understand meta data and tags (how to use them, how to extract them, how to find links, how to find multimedia files, etc.) Web structure analysis -- understand inlink and outlink between web pages -- Search engines and Google's PageRank algorithm	
2	Lab 1 Installing Python First Python Program Use Python to process simple data Crawling Twitter Other crawling tools (e.g. Scrappy)	Lab
3, 4	Project Form groups. Practicing crawling relevant data sources for the project	Project
5	Text Representation I: how to represent a text using terms -- keyword --unigram and bigram	Lecture HW 1 due

	--stop word --frequency distribution of keyword --tfidf -- why Part-Of-Speech (POS) -- why Parse Tree -- stemming	
6	Lab 2 NLTK (1) (2)	Lab
7,8	Project Select topics for project Come up with project design -- Technical framework -- Data processing requirement -- Possible approaches	Project
9	Lecture Text Clustering --overlapping keywords --Cosine similarity -KL distance Text Classification -- understand the purpose of your classification -- keyword features	Lecture HW 2 due

	-- other features: writing style -- rule-based and machine learning	
10	Lab 3: Machine learning-based classification with WEKA	Lab
11,12	Project Approach implementation Data analysis Evaluation	Project
13	Sentiment Analysis -- Lexicon-based and machine learning Social Network Analysis Study cases in web and text mining	Lecture HW 3 due
14	Lab 4: Sentiment Analysis – Python Use Gephi for link analysis	Lab
15,16	Project Presentation	Project
	Online Exam Project report	

《电路基础实验》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE111L

课程名称:	电路基础实验	英文名称:	Electric Circuits Lab
学 分:	1	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

《电路基础实验》通过一系列的课程实验，使学生巩固和扩展所学的理论知识；熟悉基本的实验设备和电子元件的使用方法；了解简单电路模块的搭建和测试方法；锻炼分析和解决实际问题的能力；学习对实验结果进行分析与处理的方法；养成良好的实验习惯和严谨的科学作风。

三、教学内容、教学方式和学时安排

实验一 常用电子仪器仪表以及电路仿真软件介绍
实验二 三端变阻器
实验三 戴维南等效电路
实验四 含有非独立电源的电路的研究
实验五 RC 电路频率特性的研究
实验六 RLC 串联电路的幅频特性和谐振现象
实验七 电路过渡过程的研究
实验八 开放性实验

《信号与系统实验》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE150L
课程名称:	信号与系统实验	英文名称:	Signals and Systems Lab
学 分:	1	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

信号与系统的配套实验课程，通过实验的手段帮助学生更好的理解理论课中较为抽象的内容，引导学生进行验证、探索等。同时掌握 MATLAB 在信号处理领域的应用。

三、教学内容、教学方式和学时安排

课程共包含 6 个实验，每两周完成一个。学生将于双周完成课程材料的阅读、资料的查询、实验预习报告等。在单周，由教师或 TA 对课程进行讲解及答疑，并组织课堂实验。每周的学习大约需要占用 3 个小时，实验内容如下：

Lab 1 Introduction to MATLAB

- What is MATLAB
- Desktop of MATLAB
- Create Variables
- Data Types
- Plotting Function
- Representation of Elementary Signal
- Operation of Signals
- Program Structure
- Have Fun

Lab 2 System Analysis in Time Domain

- Scripts and Functions
- Zero-Input and Zero-State Response (Symbolic Method)
- Zero-State Response (Numerical Method)
- Impulse Response and Step Response (Numerical Method)
- Subs
- Convolution Operation

Lab 3 Analysis of Periodic Signals in the Frequency Domain

- Fourier Series of Periodic signal
- Frequency Analysis of Periodic Signal
- GUIDE

Lab 4 Fourier Transform

- Fourier Transform and Inverse Fourier Transform with Symbolic M ethod
- Fourier Transform with Numeric Method
- Signal Analyzer APP

Lab 5 Laplace Transform

- Laplace Transform and Inverse Laplace Transform
- Poles and Zeros
- Surface Plot for Laplace Transform

- Relationship between Laplace Transform and Fourier Transform

Lab 6 Sampling and Reconstruction

- Sampling
- Reconstruction

《算法与数据结构》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS101
课程名称:	算法与数据结构	英文名称:	Algorithms and Data Structures
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces the mathematical modeling of computational problems. It covers basic data structures and algorithms for solving these problems, and performance measurement and analysis techniques for these problems. Topics include:
Basic algorithm design and analysis: performance measurement, asymptotic notations.
Elementary data structures: linked lists, stacks, queues.
Trees: binary search trees, balanced trees/AVL-trees, disjoint sets.
Hashing: hash functions and tables.
Graph algorithms: breadth-first search, depth-first search,
topological sort, minimum spanning trees, single-source shortest paths/A*.
Sorting: merge, heap, and quick sort.
Advanced algorithm design techniques: divide and conquer, dynamic programming, NP Completeness.

三、教学内容、教学方式和学时安排

Introduction	Week 1

Algorithm Basics	Week 2
Elementary Data Structures	Week 3
Trees	Week 4-6
Hashing	Week 7
Graph Algorithms	Week 8-9
Exam	Week 10
Sorting	Week 11-12
Advanced Algorithm Design	Week 13-16

《模拟与数字电路》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE115
课程名称:	模拟与数字电路	英文名称:	Analog and Digital Circuits
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers multiple topics about analog and digital circuits design. Analog session: introduction of signals and amplifiers, operational amplifiers, semiconductor basics, diodes, MOS field effect transistor, Bipolar junction transistor, transistor amplifier, and some basic building blocks of integrated-circuits amplifiers. Digital session: Number systems, operations and codes, logic gates, Boolean algebra and logic simplification, combinational logic, latches, flip-flops, and timers.

三、教学内容、教学方式和学时安排

Lectures

Week	*Lecture topics*	*Homework*
1	introduction of signals and amplifiers	
2	operational amplifiers	
3	semiconductor basics	

4	diodes	*Homework 1*
5	MOS field effect transistor	
6	Bipolar junction transistor	
7	transistor amplifier	
8	basic building blocks of integrated-circuits amplifiers	*Homework 2*
9	Number systems	*Project 1 deadline*
10	operations and codes	*Mid-term exam*
11	logic gates	
12	Boolean algebra and logic simplification	*Homework 3*
13	combinational logic	
14	latches, flip-flops, and timers	
15	Reserve for project presentation	
16	Reserve for project presentation	*Project 2 deadline*

**Topics may vary a bit throughout the preparation of the lectures.*

《软件工程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS132
课程名称:	软件工程	英文名称:	Software Engineering
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

在实际应用中，复杂软件通常由一个团队分工合作完成。软件工程是研究如何在团队合作中提升软件开发效率，减小沟通成本的一门学科。在本课程中，同学们将通过课程及项目实践理解如下知识与技能：
什么是软件工程？为什么叫软件“工程”而不是软件“科学”？
软件开发周期中的步骤及分工
如何利用需求分析将用户需求分解为软件需求
如何在开发过程中维护软件可追溯性，确保软件需求被完整的实现
如何利用软件测试与验证保证软件的安全性与正确性
如何在保证可追溯性的前提下对原有软件进行修改

良好的编程以及记录习惯

三、教学内容、教学方式和学时安排

本课程的教学和实践主要分为如下几个阶段：

- 阶段 1：软件工程简介
  - 了解软件工程基本原理以及应用场景
- 阶段 2：基于模型的软件开发流程
  - 如何建立软件模型
  - 如何为软件运行环境建立模型
  - 利用模型验证提供早期软件正确性证明
  - 软件测试原理
  - 利用模型生成软件测试集
  - 利用模型生成代码
- 期中考试
- 阶段 3：良好的编程以及记录习惯
- 阶段 4：项目实践与团队合作
  - 通过项目实践的方式体验团队合作中不同角色
- 期末考试

《生物信息学：软件开发与应用》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS177H
课程名称:	生物信息学：软件开发与应用	英文名称:	Bioinformatics: Software Development and Applications
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Bioinformatics is an interdisciplinary field mainly about ap
plying information science and technology to biological and
medical sciences. Algorithms and software tools play pivotal

roles in the development of Bioinformatics and its practical applications. This course provides a comprehensive introduction to the software tools and their underlying algorithms in Bioinformatics. Through a tour of widely used software tools in Bioinformatics and Computational Biology, students will get a solid understanding of the algorithmic and software technologies involved and obtain skills to design new algorithms and software. Moreover, students will also learn how to apply the software to solving problems of biomedical data science. The main form of instruction is lectures and discussion. In addition, hands-on tutorials, assignments and projects will be used to train the practical skills of software design and implementation.

三、教学内容、教学方式和学时安排

Schedule	Teaching Content	Teaching Form
Week 1, 4 hours	1. Introduction to the course (objectives, policies, rules, etc.) 2. Introduction to bioinformatics 3. Basics of molecular biology	Lecture, discussion
Week 2, 4 hours	1. Introduction to algorithms 2. Introduction to statistics, data mining and machine learning	Lecture, discussion
Week 3, 4 hours	1. Resources: Databases, software tools, open-source code 2. Introduction to software development: Programing languages, package development, building databases and web-servers	Lecture, discussion Homework assignment 1
Week 4, 4 hours	Genomic analysis I: 1. Sequence comparison (sequence alignment, string matching, motif finding)	Lecture, discussion

	2. Next Generation Sequencing data (genome assembly, read mapping, etc.)	
Week 5, 4 hours	Genomic analysis II: 1. SNPs, structural variation, QTL/GWAS 2. Epigenomics (ChIP-seq, ATAC-seq, Hi-C)	Lecture, discussion Homework Assignment 2
Week 6, 4 hours	Transcriptomic analysis: 1. Microarray and RNA-seq data processing and analysis 2. Other topics about RNA: Alternative splicing, RNA editing, noncoding RNA, RNA secondary structure, etc.	Lecture, discussion Projects start
Week 7, 4 hours	Practical coding and data skills: 1. Use Linux, Python and R 2. Version control with Git 3. Shell scripting and writing pipelines 4. Data processing and management 5. Visualization	Tutorials
Week 8, 4 hours	Protein related topics: 1. Proteomics 2. Protein structure	Lecture, discussion Homework Assignment 3
Week 9, 4 hours	Systems biology: 1. Protein-protein interaction network, gene regulatory network, signaling network, metabolism 2. Cell modeling, single-cell data analysis (revisited)	Lecture, discussion

Week 10, 4 hours	Molecular evolution: 1. Population genetics 2. Phylogenetic reconstruction and analysis 3. Comparative genomics	Lecture, discussion
Week 11, 4 hours	Project presentations Discussions of additional topics (e.g. text mining, deep learning, genome editing)	Lecture, discussion Student presentations
Week 12, 4 hours	Project presentations Discussions of additional topics (e.g. text mining, deep learning, genome editing)	Lecture, discussion Student presentations
Week 17, 2 hours	Final exam	

Schedule	Teaching Content	Teaching Form
Week 1, 4 hours	1. Introduction to the course (objectives, policies, rules, etc.) 2. Introduction to bioinformatics 3. Basics of molecular biology	Lecture, discussion
Week 2, 4 hours	1. Introduction to algorithms 2. Introduction to statistics, data mining and machine learning	Lecture, discussion
Week 3, 4 hours	1. Resources: Databases, software tools, open-source code 2. Introduction to software development: Programing languages, package	Lecture, discussion Homework assignment 1

	development, building databases and web-servers	
Week 4, 4 hours	Genomic analysis I: 1. Sequence comparison (sequence alignment, string matching, motif finding) 2. Next Generation Sequencing data (genome assembly, read mapping, etc.)	Lecture, discussion
Week 5, 4 hours	Genomic analysis II: 1. SNPs, structural variation, QTL/GWAS 2. Epigenomics (ChIP-seq, ATAC-seq, Hi-C)	Lecture, discussion Homework Assignment 2
Week 6, 4 hours	Transcriptomic analysis: 1. Microarray and RNA-seq data processing and analysis 2. Other topics about RNA: Alternative splicing, RNA editing, noncoding RNA, RNA secondary structure, etc.	Lecture, discussion Projects start
Week 7, 4 hours	Practical coding and data skills: 1. Use Linux, Python and R 2. Version control with Git 3. Shell scripting and writing pipelines 4. Data processing and management 5. Visualization	Tutorials
Week 8, 4 hours	Protein related topics: 1. Proteomics 2. Protein structure	Lecture, discussion Homework Assignment 3

Week 9, 4 hours	Systems biology: 1. Protein-protein interaction network, gene regulatory network, signaling network, metabolism 2. Cell modeling, single-cell data analysis (revisited)	Lecture, discussion
Week 10, 4 hours	Molecular evolution: 1. Population genetics 2. Phylogenetic reconstruction and analysis 3. Comparative genomics	Lecture, discussion
Week 11, 4 hours	Project presentations Discussions of additional topics (e.g. text mining, deep learning, genome editing)	Lecture, discussion Student presentations
Week 12, 4 hours	Project presentations Discussions of additional topics (e.g. text mining, deep learning, genome editing)	Lecture, discussion Student presentations
Week 17, 2 hours	Final exam	

《医学影像学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE101
课程名称:	医学影像学	英文名称:	Medical Imaging
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:	概率论与数理统计		

二、课程简介和教学目的

本课程为医学影像学的入门介绍课程，目的是为医学影像学的学习和研究奠定物理基础。课程将重点讲解 x 射线成像、CT、MRI、核医学成像、超声成像等目前广泛使用的医学成像方法及其特点，同时还将介绍医学图像基础、图像质量保证和控制、辐射防护的基本原理等成像基础知识。通过本课程的训练，学生需认识和掌握医学影像的基本成像原理和方法，了解医学图像诊断的物理学依据。

三、教学内容、教学方式和学时安排

课程内容:

1. 医学图像基础
2. X 射线物理及成像
3. CT 成像及三维图像重建
4. 核磁成像
5. 核医学物理及成像
6. 超声物理及成像
7. 图像质量控制
8. 医学辐射防护

《信息科学技术导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100D
课程名称:	信息科学技术导论	英文名称:	Introduction to Information Science and Technology
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

The objective of this course is to provide new undergraduate students with a thorough introduction to key concepts and applications of computer science, electrical and electronic engineering, and information engineering. This course takes the form of lectures by a diverse set of faculty from the School of Information Science and Technology and covers a wide range of topics. At the end of this course students will understand the key disciplines and concerns within information science and technology, interrelationships between its various facets, and learn about milestones in the theoretical development and practical application of CS, EEE and IE.

三、教学内容、教学方式和学时安排

The course will have totally 28-32 lectures.

《物理光学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE131H
课程名称:	物理光学	英文名称:	Physical Optics
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程将从光的波动本质出发来介绍光的性质，包括光的偏振特性，干涉特性，和衍射特性，并从物理光学的角度来解释光学成像系统中的解析度极限问题。在本课程中，我们将采用物理光学来对光学的基本定理和基本现象进行讨论。

三、教学内容、教学方式和学时安排

1. 波动

-谐波，相位和相速度，叠加原理，复数表示，平面波，球面波和柱面波

2. 电磁理论、光子和光

- 电磁波，能量和动量，光在大块物质中，电磁-光子谱

3. 光的传播

- 瑞利散射，反射，折射，电磁学研究方法，全内反射，金属的光学性质，光和物质的相互作用

4. 波的叠加

- 同频波的叠加、异频波的叠加、非谐周期波、非周期波

5. 偏振

- 偏振光的本质，起偏器，二向色性，双折射，散射和偏振，反射引起的偏振，推迟器，圆偏振器

6. 干涉

- 发生干涉的条件，分波阵面干涉仪，分振幅干涉仪，多束光的干涉，单层和多层薄膜的应用

7. 衍射

- 夫琅和费和菲涅尔衍射, 傅里叶变换在衍射中的应用, 通过全息衍射实现波前的重建

《电力电子》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE171
课程名称:	电力电子	英文名称:	Power Electronics
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

电子技术包括信息电子技术和电力电子技术两大分支。信息电子技术主要用于信息处理，而电力电子技术则主要用于电力变换。通常所说的模拟电子技术和数字电子技术都属于信息电子技术。电力电子技术是应用于电力领域的电子技术。具体说，就是使用电力电子器件对电

能进行变换和控制的技术。所用的电力电子器件均用半导体制成，故也称为功率半导体器件。电力电子技术所变换的“电力”，功率可以大到数百 MW 甚至 GW，也可以小到数 W 甚至 1W 以下。

三、教学内容、教学方式和学时安排

Chapter 1: Introduction

Chapter 2: Principles of steady-state converter analysis

Chapter 3: Steady-state equivalent circuit modeling, losses, and efficiency

Chapter 4: Switch Realization

Chapter 5: The Discontinuous Conduction Mode

Chapter 6: Converter Circuits

Chapter 7: Rectifier and Inverter

Chapter 8: Advanced power conversion techniques

《计算科学与工程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI114H
课程名称:	计算科学与工程	英文名称:	Computational science and engineering
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

作为数学工具，计算科学在数学学科与其它科学技术领域都有着广泛的应用。在已掌握本科阶段数学分析（或高等数学）与线性代数知识的基础上，学生通过本课程的学习可以系统的掌握科学计算的相关知

识，培养抽象思维能力、科学计算能力、科学研究能力，从而提高解决实际问题的能力。

三、教学内容、教学方式和学时安排

1. Computational Linear Algebra (8 Lectures)

2. Applied Partial different Equations (16 Lectures)

3. Numerical Methods (16 Lectures)

4. Introduction for Advanced Topics (8 Lectures)

《数字图像处理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS270
课程名称:	数字图像处理	英文名称:	Digital Image Processing
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本门课程介绍了图像处理的基础概念、常用算法和技术。重点讲授了图像的感知，量化，增强，复原，配准，差值，压缩，分割，识别等多方面的图像处理方法。课程要求学生在学期中共同参与知识细节的完善（课上报告环节），按时提交作业，按时参加随堂测试，并在学期末综合运用所学到的基础处理方法完成课程设计。

三、教学内容、教学方式和学时安排

第一周: 课程简介和数字图像基础。

第二周：像素间基本知识。

第三周：图像感知和获取；图像处理数学工具。

第四周：图像差值。

第五周：灰度变换。

第六周：空间滤波。

第七周：频域滤波。

第八周：图像复原（上）。

第九周：图像复原（下）。

第十周：图像配准与图像压缩。

第十一周：形态学图像处理。

第十二周：图像分割。

第十三周：目标识别。

第十四周-第十五周：课程设计。

第十六周：课程设计报告。

《硅射频集成电路设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290S
课程名称:	硅射频集成电路设计	英文名称:	SiCMOS RF IC Design
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

The course will present the basic concepts an design guidelines for RFIC blocks as well as adjacent blocks such as bias system, compensation blocks, AMP, filters .. Combined with assignments and design practice, some basic skills will be setup for students to go into deep design study.

三、教学内容、教学方式和学时安排

Week 2: introduction and practical things In this section

Week3: RFIC concept and problems

Week4-week10: RF Blocks design

Week11-13: adjacent blocks

Week14-15: design practice

Week16: design review and exam,

《智能医疗仪器软件的设计与验证》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS233
课程名称:	智能医疗仪器软件的设计与验证	英文名称:	Software Development and Validation for Medical Cyber Physical Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

随着科技的进步，医疗仪器在复杂疾病的诊断与治疗过程中起着日趋重要的作用。传统的医疗仪器如 X 光机或输液泵只有辅助诊断或者是辅助治疗其中一种功能，医护人员在诊断以及治疗的过程中有着最终的决定权。而逐渐涌现的智能医疗仪器（如植入式心脏起搏器）可一定程度上实现自主的诊断与治疗，在提供更及时治疗的同时减少医护人员的负担，提高病人的生活水平。智能医疗仪器的自主性由日趋复杂的软件系统提供，而这些软件系统的误诊断及误操作会对病人的健康和生命造成重大的损失，因而智能医疗仪器软件系统的开发及监管需要一套更加严谨的流程。智能医疗仪器软件的开发与验证是一项系统工程，在每个环节都需要医疗、工程、计算机科学以及审批等领域专家的通力合作。这些趋势也对教育工作者也提出了更高的要求，力争培养具有系统工程思维和跨专业理念的新型工程师队伍。
通过课程教学以及实践，希望学生能够获得以下的知识、技能以及洞见：

理解和体验智能医疗仪器的跨学科特性

体验医学、工程、计算机科学、审批等多方视角及相应的挑战

与其他领域的专家交流合作的技术与经验

掌握软件工程相关技术以及理念

在将需求转化为设计的过程中体验跨学科合作的必要性

掌握并理解软件设计 V 模型

理解并体验软件验证的必要性

掌握基于模型的软件设计的相关技术与理念

理解基于模型的设计如何应对软件工程中的各种挑战

理解对系统所处生理环境建模的必要性

掌握模型检测的基本概念以及应用

理解模型抽象化及细节化在模型验证与仿真中的重要性

掌握软件测试的原理及应用

掌握代码生成的工具

了解嵌入式软件开发的基本流程

理解嵌入式软件对于实时性的要求

了解和体验医疗仪器的审批过程

了解医疗仪器审批的作用以及理念

了解各个审批环节所针对的问题

利用 assurance case 整理证据来支撑软件安全及性能保障

了解和体验医疗仪器临床试验的过程（optional）

理解和掌握临床试验的原理和方法

如何利用生理模型来辅助医疗仪器的临床试验

三、教学内容、教学方式和学时安排

本课程要求学生从软件需求到代码实现一个简易的植入式心脏起搏器软件，并且利用课堂上讲授的知识和方法解决在开发过程中遇到的问题。

- 课程简介
- 第一阶段：心脏电生理原理以及建模
    - 心脏电生理简介
    - 心律紊乱的电生理机理
    - 使用电生理检查（EP Testing）诊断心律紊乱
    - 心脏电生理时序模型的建立
        - 作业：使用心脏电生理时序模型仿真
- 第二阶段：双腔（Dual Chamber）植入式心脏起搏器软件的原理及建模
    - 植入式心脏起搏器发展历程
    - 单腔植入式心脏起搏器建模
    - 双腔植入式心脏起搏器建模
        - 作业：使用常见心电状况的心脏电生理模型与双腔植入式心脏起搏器模型进行闭环仿真

- 第三阶段：基于模型的软件验证
    - 基于模型的软件测试原理简介
        - 作业：植入式起搏器测试集的生成
    - 模型检查原理
    - 时序状态机与 UPPAAL 模型检查工具
    - 心脏电生理的时序状态机模型
    - 需求工程简介
        - 作业：植入式起搏器软件模型的模型检查
    - 双腔植入式心脏起搏器软件常见问题
    - 基于模型的代码生成
- 期中考试
- 第四阶段：起搏器软件的硬件实现 （1 实验学分）
    - 将之前开发的起搏器软件在 Arduino 开发板上运行并测试
- 第五阶段：医疗仪器软件审批
    - 医疗仪器审批的理念及程序
    - Assurance Case
    - 作业以及结课报告：使用 assurance case 提供起搏器软件安全证明

《电磁传感与检测》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE236
课程名称:	电磁传感与检测	英文名称:	Electromagnetic Sensing and Testing
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程主要讲授电磁传感与检测的基本原理、方法与应用，包括信号获取的原理与方法，信号的调理与转换电路，检测信号与图像的分析

处理等。本课程的教学目的是：通过课堂教学和实验教学，让学生了解常见的电磁传感与检测技术，熟悉基本的电磁检测系统，掌握电磁检测图像的分析处理方法，培养相关领域的杰出工程师和科研工作者。

三、教学内容、教学方式和学时安排

课堂教学 48 学时,包括以下教学内容：

涡流检测, 漏磁检测，微波检测，红外检测，X 射线检测，核磁共振检测与成像等。

实验 16 学时，包含以下实验：

金属表面缺陷检测；

电导率测量；

深层缺陷检测；

红外热成像检测；

X-ray 缺陷检测；

CT 图像分析和处理。

《机械设计导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI102H
课程名称:	机械设计导论	英文名称:	Mechanical Design
学 分:	3	学 时:	48
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course is a course open for students from the entire university (although the main target is SPST and SIST). Its objective is to build the engineering foundation for students on how to visualize parts before construction, how to design

these parts, how to predict failure modes their failure modes and how to build these. The main motivation for this class is to cover the gap between SIST and SPST, as one offers Engineering courses (IE, EE and CS) and the other Material Science courses, and consequently Mechanical and Structural Engineering are left without a representation between these two. The Mechanical Design course will have 32 hours of theoretical classes followed by a design project, which will require the knowledge learned in class. While the theoretical part will be assessed with one exam and two in class courseworks, the practical part will require one technical report and one final demonstration. At the end of the course students are expected to show a deeper understanding on why engineers make decisions while developing their products, on how things work in the world that we live in and how to improve designs, and this mindset will better prepare them for the job market, independent of their background.

This course is open to undergraduate students from the 2nd, 3rd and 4th year. It will focus on:
Notions of Heat transfer: Conduction; Convection; Radiation
Mechanics of materials: Free body diagram, Analysis of loads, Truss structures, Elastic and plastic regime; Stress/strain; Transverse, axial and torsional loadings; Compressive, tensile and sheer stress; Tensile strength and Young Modulus.
Notions of Solidworks (with the help of Dr. Lv Kunyong) to proceed to notions of Finite Element Analysis

Courseworks will happen in specific days to test the knowledge absorbed by the students in class. A significant part of the course will be a project. It will include a technical report, where students will draft their plan with required design, calculations and considerations before their construction. The Technical Report will account for 25% of the Final project’s grade.
After the construction of their final report starts the students, separated in teams of 5, will be given the necessary materials to build their project, and another 25% of their Final Project’s grade will be given to the Product Evaluation aspect. Finally, the last 50% of the Final Project’s grade will be given to the performance of the team at the final demonstration of their project. Their product will go through a strenuous test and the teams will be graded according to

their performance when compared to the performance from othe r teams.

三、教学内容、教学方式和学时安排

Week 1	Introduction to the course Notions of Heat Transfer	
Week 2	Introduction to Structural Engineering Free body diagram	
Week 3	Truss structures, Tensegrity Elastic and Plastic regimes, Stress/Strain	First Coursework
Week 4	Axial Loadings, Exercises	
Week 5	Torsional loadings, Exercises	
Week 6	Transverse Loadings and Combination of Loadings	Mid-term Exam
Week 7	Designing simple parts on Solidworks	
Week 8	Finite Element Analysis	Second Coursework
Week 9-12	Projects (project meetings twice per week during lecture hours. Close guidance to make sure that construction happens without incidents. Collaboration with the H2 building and Tang Feilong to build wood parts)	Technical Report
Week 12	Project presentation	

《微纳加工工艺实验》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE224L
课程名称:	微纳加工工艺实验	英文名称:	Micro/Nano-fabrication Lab
学 分:	2	学 时:	64

授课对象:		授课语言:	中英文
先修课程:	微纳加工与微机电系统基础		

二、课程简介和教学目的

Hand-on experience for basic micro-/nano-machining process including photolithography, deposition, etching, releasing, as well as MEMS transducer fabrication and characterization.

三、教学内容、教学方式和学时安排

Lecture	Topic
1	Chemical Safety and Cleaning Procedures
2	Process Flow and Mask Layout
3	Photolithography
4	Wet Etching
5	Dry Etching
6	Physical Vapor Deposition
7	Chemical Vapor Deposition
8	Atomic Layer Deposition
9	Process Integration and TCAD
10	MEMS Device
11	Semiconductor Analyzer
12	Impedance Analyzer
13	Magnetic Characterization
14	Scanning Probe Microscopy
15	Vibrometer
16	Resonator Characterization
	Homework/Lab/Project assignments will be adjusted/distributed according to the resources and student background

《网络理论与分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290U
课程名称:	网络理论与分析	英文名称:	Network Theory and Analytics
学 分:	2	学 时:	32

授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The science of networks is an emerging discipline of great importance that combines graph theory, probability and statistics, and facets of engineering and the social sciences. Topics in this course will help answer intriguing questions such as: Where does ″six degrees of separation″ come from? How can we make sense of large graphs, ranging from social networks to the smart power grid? What are the underpinnings of Google's search engine and webpage ranking? What are good models for predicting popularity in Twitter? How can we estimate the size of the Internet?
Objectives: This course will provide students with the mathematical tools and computational training to understand large-scale networks in the current era of Big Data. It will introduce basic network models and structural descriptors, network dynamics and prediction of processes evolving on graphs, modern algorithms for topology inference, community and anomaly detection, as well as fundamentals of social network analysis. All concepts and theories will be illustrated with numerous applications and hands-on case studies from technological, social, biological, and information networks.

三、教学内容、教学方式和学时安排

The course will cover the following units/topics:

1) Introduction and overview. Why study networks?

2) Preliminaries: background on graphs, probability, and optimization theory.

3) Descriptive analysis of networks: centrality, cohesion, and communities.

4) Fundamentals on social network analysis.

5) Mapping networks, visualization of large graphs.

6) Sampling and estimation in network graphs

7) Network models: random, small-world, preferential attachment.

8) Network topology inference: link prediction, tomographic inference.

9) Modeling and prediction for processes evolving over network graphs.

10) Analysis of network flow data.

Those can be group into three main blocks:

I. Descriptive analysis and properties of networks
II. Sampling, modeling and inference of/in networks
III. Processes evolving over networks

Detailed schedule:

Week	Topics covered
1	Introductions, class organization, networks, context, examples
	Graphs, digraphs, degrees, movement, strong and weak connectivity
	Families, algebraic graph theory, data structures and algorithms
	Inference, models, point and set estimates, hypothesis testing
2	Tutorials on inference about a mean and linear regression
	Graph visualization, stages of network mapping, mapping Science
	Large graph visualization, k-core decomposition, Internet mapping
	Degree distributions, Erdos-Renyi random graphs and power laws
3	Visualizing and fitting power laws, preferential attachment
	Closeness, betweeness and eigenvector centrality measures
	Web search, hubs and authorities, Markov chains review
	PageRank, fluid and graph random walk models, distributed algorithms
	Cohesive subgroups, clustering, connectivity, assortativity mixing
4	Strength of weak ties, community structure in networks
	Girvan-Newmann method, hierarchical clustering, modularity
	Modularity optimization, graph cuts, spectral graph partitioning
	Sampling, Horvitz-Thompson estimation, graph sampling designs
	Network estimation of totals, groups size, degree distributions
5	Random graph models, model-based estimation, significance, motifs
	Small-world, preferential attachment and copying models
	Exponential random graph models, construction and estimation
	Topology inference, link prediction, scoring and classification
	Inference of association networks, tomographic inference
6	Nearest-neighbor prediction of processes, Markov random fields
	Graph kernel-regression, kernel design, protein function prediction
	Diseases and the networks that transmit them, epidemic modeling
	Network flow data, routing and traffic matrices, gravity models
	Traffic matrix estimation, network flow costs, network kriging

《C++进阶编程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS133H
课程名称:	C++进阶编程	英文名称:	Advanced Programming in C++
学 分:	3	学 时:	48
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course is an elective follow-up course to CS100 - Introduction to Programming - and provides participants with an opportunity to deepen their skills in one of the most popular object-oriented programming languages for the effective implementation of resource-hungry problem solutions: C++. In particular, the course will include an introduction practical mathematical optimization, which will be helpful for the solution of many engineering research problems. A particular focus will be put on the efficient solution of linear and non-linear optimization problems. The course aims at strengthening fundamental practical skills, and thus directly contributes to an improved preparation for future job and higher-degree research opportunities.

Course organization:

The number of students in this course is limited to 80, as this will still encourage interaction through in-class examples. Students will be evaluated primarily through homework assignments, and a semester project for which topics will be proposed by the instructor. The group size of the semester projects will be decided depending on the number of participants. An example topic of a semester project could be the implementation and interfacing of a large optimization problem solver.

The homework assignments will involve coding. Templates, interface definitions, as well as a common coding standard/compiler will be provided, which will allow a streamlined, fair grading of the assignments. Assignments will be introduced during the lectures as well as posted on the course webpage (along with the dates and deadlines).

三、教学内容、教学方式和学时安排

The course will go over 12 weeks. The following is a tentative curriculum. Note that the course will be designed in an interactive fashion where student participation is maximized through in-class coding examples. Time will be used flexibly to ensure the interactive participation of the students. Part of the material is drawn from books: Effective C++ (Scott Meyers), and Design Patterns (Gannam, Helm, Johnson, Vlissides).

Week	Topic	assignment
1	Course introduction, Introduction of development environment	
1	Short revision of C++	
2	Introduction into coding standards	
2	Introduction into cmake	
3	Managing large projects, version control	
3	General coding rules I	
4	General coding rules II	Ass. 1 release / Project selection
4	General coding rules III	
5	Design patterns: Creational patterns	
5	Design patterns: Structural patterns	Ass. 1 deadline / Ass. 2 release
6	Design patterns: Behavioral patterns	
6	Introduction to Boost I	Ass. 2 deadline / Ass. 3 release
7	Introduction to Boost II	
7	Introduction to Eigen	Ass. 3 deadline / Ass. 4 release
8	Basics of Mathematical Optimization	
8	Gradient-free optimization in practice	Ass. 4 deadline / Ass. 5 release

9	Generic implementation of gradient descent	
9	Generic implementation of gauss-newton	Ass. 5 deadline / Ass. 6 release
10	Interfacing with Matlab	
10	Interfacing with Python	Ass. 6 deadline
11	Extended instruction sets (SSE)	
11	Cross-platform compatibility	
12	Extended instruction sets (neon)	
12	Summary	Project presentations

《应用代数几何》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI192
课程名称:	应用代数几何	英文名称:	Applied Algebraic Geometry
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

An undergraduate level introduction to the mathematics, algorithms and applications of polyno-mial equations. A final project will give students the opportunity to research problems in the in-tersection of computer science and electrical engineering with algebraic geometry. The course is more appropriate for third and fourth year undergraduate students as well as graduate students.

三、教学内容、教学方式和学时安排

Basic objects of commutative ring theory: ideals, modules, quotient rings. *Polynomial rings over a field:* monomial ideals, initial ideals, monomial orders, division algorithm. *Groebner basis:* Buchberger's criterion, Buchberger's algorithm, Hilbert's Basis Theorem. *Topological aspects of r*

oots of polynomial equations: Zariski topology, algebraic varieties. *Equival ence between algebra and geometry:* Hilbert's Nullstellensatz. *Dimension o f an algebraic variety:* algebraic and geometric characterizations via Noeth er normalization, Hilbert series, generic hyperplane sections and initial line ar spaces. *Solving polynomial equations:* elimination theory, linear algebra in a high-dimensional space. *Applications:* fundamental matrix and trifocal tensor in computer vision, generalized principal component analysis, shuffl ed linear regression and matrix completion in data science, path planning a nd kinematic problems in robotics. *Software:* Introduction to Macaulay2, a nd to Bertini and its MATLAB interface. *Final Project:* A research project of the student's preference in the intersection of algebraic geometry and co mputer science or electrical engineering (suggestions will be provided).

《高阶分布式系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS290K
课程名称:	高阶分布式系统	英文名称:	Advanced Distributed Systems
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

In this course, we will address the issues of design of dist ributed systems. In particular, we will investigate successf ul approaches in the form of abstract models, algorithms, an d cases studies of real-world systems. We presume that stude nts who will take this class have a basic knowledge of opera ting systems, computer architecture, and object oriented pro gramming. The course will be research intensive, aiming at d eriving practical and achievable ground rules for distribute d systems design. Each student is expected to do a project i ncluding a written report and an in-class presentation on a topic to be arranged with the instructor. Each student is ex pected to collaborate with other students toward the complet ion of a research project related to distributed systems.

三、教学内容、教学方式和学时安排

June 24

Morning Lecture 1 (Class Guidelines & Chapter1 “Characterization of Distributed Systems”)

Lecture 2 (Chapter 2 “System Models”)

Afternoon Lecture 3 (Chapter 4 “Interprocess Communication”)

Lecture 4 (“How to conduct research in computer science? [part 1])

June 26

Morning Lecture 5 (“How to conduct research in computer science? [part 2])

Lecture 6 (Chapter 5&8 “Distributed Objects and Remote Invocation”)

Afternoon Lecture 7 (Chapter 5&12 “Events and Distributed File Systems”, Part 1)

Lecture 8 (Chapter 12 “Distributed File Systems”, Part 2)

July 1

Morning Lecture 9 (A sample research project)

Lecture 10 (Chapter 10 “Peer-to-Peer Systems”)

Afternoon Lecture 11 (Chapter 14 “Time and Global State” [Part 1])

Lecture 12 (Chapter 14 “Time and Global State” [Part 2])

July 3

Morning Lecture 13 (Chapter 15 “Coordination and Agreement” [Part 1])

Lecture 14 (Chapter 15 “Coordination and Agreement” [Part 2])

Afternoon Lecture 15 (Chapter 15 “Coordination and Agreement” [Part 3])

Lecture 16 (Chapter 15 “Coordination and Agreement” [Part 4])

July 8

Morning Lecture 17 (Chapter 16 “Transactions and Concurrency Control” [Part 1])

Lecture 18 (Chapter 16 “Transactions and Concurrency Control” [Part 2])

Afternoon Lecture 19 (Chapter 16 “Transactions and Concurrency Control” [Part 3])

Lecture 20 (Chapter 17 “Distributed Transactions” [Part 1])

July 10

Morning Lecture 21 (Chapter 17 “Distributed Transactions” [Part 2])

Lecture 22 (“Preview for Final Exam”)

Afternoon Lecture 23 (Chapter 18 “Replication” [Part 1])

Lecture 22 (Chapter 18 “Replication” [Part 2])

July 15

Morning Lecture 24 (Chapter 11 “Security” [Part 1])

Lecture 25 (Chapter 11 “Security” [Part 2])

Afternoon Lecture 26 (“Computer Science Technical Paper Writing” [Part 1])

Lecture 27 (“Computer Science Technical Paper Writing” [Part 2])

July 17

Morning Group Presentations

Afternoon Final Exam

《微电子器件》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE123
课程名称:	微电子器件	英文名称:	Microelectronic Devices
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

该课程主要面向半导体器件方向的高年级本科生。课程主要涵盖了半导体微电子器件物理和设计原则，高频器件噪音分析，以及关于各类新型两端/三端微电子器件的介绍和研发现状。

三、教学内容、教学方式和学时安排

课程环节（48 学时）

第一讲: 半导体物理回顾（6 学时）Lattices, Brillouin zone and symmetry, energy bands in bulk, E-k relations, Block functions, Si and GaAs, quantum confined structures, densities of states and statistics, carrier density, Boltzmann transport equation.

第二讲: 半导体射频器件噪音分析（6 学时）Thermal noise, shot noise, flicker noise, diffusion noise, impact ionization noise, noise figure

第三讲 两端微电子器件 1– 微波信号分析与处理（6 学时）power detection, frequency conversion (signal mixing), amplitude control (RF attenuator), Phase control (phase shifter), RF switching, fundamental oscillator, harmonic generator, frequency upconverter, Parametrically induced negative resistance, Internally generated negative resistance

第四讲: 两端微电子器件 2 – Junction 器件（6 学时）pn-junction, Tunnel diodes, Schottky diodes and application to detecting and mixing, Varactor diodes and application to multipliers, frequency converters, other parametric applications, PIN diodes, Step recovery diodes

第五讲: 两端电子器件 3 – Transit-Time 器件（6 学时）Transferred electron devices, Impact Ionized Transit Time (IMPATT) devices, Other transit time devices including Resonant Tunneling Device (RTD)

第六讲: 三端电子器件 1 – 硅基三极管与场效应管器件（6 学时）Bipolar junction transistor (BJT), field effect Transistor (FET), metal-on-semiconductor FET (MOSFET) and noise model, integrated circuits fabrication process

第七讲: 三端电子器件 2 – 化合物半导体微电子器件（6 学时）Metal-Semiconductor FET (MESFET) and noise model, Heterojunction Bipolar Transistor (HBT) and noise model, High Electron Mobility Transistor (HEMT) and noise model

第八讲：极限尺度下的量子输运与自旋电子学（6 学时）Quantum transport, Landauer-Buttiker equation, introduction to spintronics

实验环节（16 学时）

利用 TCAD 软件的 40nm CMOS 工艺的器件制造与性能仿真

《子空间学习》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI232
课程名称:	子空间学习	英文名称:	Subspace Learning
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

子空间学习是一门面向无监督机器学习以及数据科学方向的研究生开展的子空间学习专题研究的导论课。目标在于介绍子空间学习方向的发展过程以及其最新研究进展，使学生能够了解传统无监督学习研究的机遇与挑战。

三、教学内容、教学方式和学时安排

本门课程将会从无监督机器学习的角度介绍子空间学习这一方向，主要内容如下：

单一子空间学习；从几何、统计以及低秩角度认识主成分分析（PCA）；鲁棒主成分分析以及其在损失数据时的变体；通过最大化期望、凸优化与交替最小化来实现矩阵补全；代数几何角度下的矩阵补全；通过递归复权最小二乘法（IRLS）或凸优化来实现的鲁棒主成分分析；L1 范数鲁棒主成分分析来应对异常值以及核范数、L21 范数、

L1 范数非凸优化集中情况下的变体；搅乱元素顺序后的鲁棒线性回归，无标记感知，压缩感知以及非线性的拓展；核主成分分析；多维情况下的计算规模扩展；局部线性的植入；拉普拉斯特征图；多子空间学习；随机采样与统一（RANSAC）；多个子空间的交集的代数几何意义；从代数几何角度来看子空间分割；K 均值逐步聚类算法；谱聚类；低秩子空间分割；稀疏子空间分割；鲁棒子空间分割。

《人工智能在科学与工程学的应用》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS286
课程名称:	人工智能在科学与工程学的应用	英文名称:	AI for Science and Engineering
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Recently, artificial intelligence (AI) techniques have become more important in the research of science and engineering, partly because of availability of large amounts of scientific data as well as the rapid advances and wide applications of deep learning methods. The main objective of this course is to enable students of different scientific backgrounds to understand and use AI techniques in their own research projects. In the lectures, after introducing fundamentals of AI methods (especially deep learning), example applications of AI to scientific fields, including but not limited to biological imaging, structural biology, and material science, will be described and explained. Through hands-on exercises in tutorials, homework and projects, students will be able to solve specific research problems using the state-of-the-art AI techniques. Furthermore, students will learn how to develop novel AI techniques to push forward frontiers in science and engineering.

三、教学内容、教学方式和学时安排

Schedule	Content of Lecture	Tutorial/Recitation	Homework / Project
Week 1	1. Introduction to the course	Set up environment for computing (e.g.	Offer a list of projects for students to choose;

	2. Introduction to artificial intelligence 3. History of applying AI to science and engineering	Python, Scikit-Learn, TensorFlow)	Students get to know each other
Week 2	1. Fundamentals of machine learning 2. Introduction to neural networks and deep learning	Hands-on exercises of running Scikit-Learn	
Week 3	1. More on deep learning (CNN, RNN, autoencoders)	Hands-on exercises of running TensorFlow for deep learning tasks	Homework 0 (on deep learning) starts; Students finish forming teams, and the course projects START!
Week 4	1. Computational challenges in genomics, transcriptomics and proteomics 2. Machine learning methods and resources (open-source data and software) for bioinformatics data analysis	Hands-on exercises of deep learning	Homework 0 due
Week 5	Deep learning in “omics” data analysis	Hands-on exercises of machine learning in bioinformatics	Homework 1 (on genomics and proteomics) starts
Week 6	Selected current topics of applying AI to genomics (e.g. single-cell data, Hi-C data, 3D genomics, genome editing)	Hands-on exercises of deep learning in “omics” data	
Week 7	1. Fundamentals of biological image analysis (history, principles and challenges) 2. Machine learning methods for biological image analysis (e.g. Cryo-EM, cell imaging)	Hands-on exercises of applying AI to recent topics of genomics	Homework 1 due
Week 8	Overview of top algorithms and software for Cryo-EM (e.g. Relion)	Hands-on exercises of biological image analysis	Homework 2 (on Cryo-EM) starts
Week 9	Case studies of deep learning for Cryo-EM	Hands-on exercises of Cryo-EM data analysis	Project progress reports due
Week 10	1. Introduction to protein structure prediction	Hands-on exercises of running deep learning for Cryo-EM	Homework 2 due

	2. Overview of PDB (protein data bank)		
Week 11	1. Introduction to CASP (Critical Assessment of Protein Structure Prediction) 2. Top algorithms for protein folding (e.g. Rosetta)	Hands-on exercises of protein structure prediction and PDB data mining	Homework 3 (on protein folding) starts
Week 12	Case studies of deep learning for protein folding (e.g. AlphaFold)	Hands-on exercises of protein folding	
Week 13	Selected topics in structural biology (e.g. molecular dynamics, protein disorder, GPCRs, drug discovery)	Hands-on exercises of deep learning for protein folding	Homework 3 due
Week 14	Introduction to AI techniques applied to physical, chemical and material science and engineering	Hands-on exercises on selected topics of structural biology	
Week 15	Machine learning for material science	Hands-on exercises of applying machine learning to material science	Schedule project presentations
Week 16	Deep learning for material science	Hands-on exercises of applying deep learning to material science	Project final reports due

《数据科学与金融科技概论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS277
课程名称:	数据科学与金融科技概论	英文名称:	Introduction to Data Science and Fintech
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces data science with a focus on its appl ications in Fintech. Within this course, the students will g

et exposure to the industry, get to know its current topics and trends and get some hands-on experience through a course project. It basically covers a broad spectrum of Fintech, including quantitative trading, Blockchain applications, regulator technology (RegTech), financial knowledge graphs, precision marketing and risk management with big data. About 10 guest speakers from the finance/Fintech industry will be invited to give talks and interact with the students. A course project related to data science and Fintech will be announced early in the semester. The students will work on the project, write reports and present the projects with the guidance from the teaching group throughout the semester. Besides, the students will also read and present data science and Fintech related papers.

三、教学内容、教学方式和学时安排

In-class lectures, talks and presentations takes up the first 11 weeks of the semester (week 1 to week 11). The class does not meet for week 12 to week 14, during which the students will focus on the course project and the teaching group will offer necessary help on the project in the form of office hours. In week 15, the class meets, during which the students will present their course projects. In total, the course takes up 24 1.5-hour slots.

8 for lectures:

Topics to be covered: 1. Overview of data science and Fintech. It will introduce common methods and tools used in the Fintech scenarios to be covered through the semester.; 2. Concepts, methods and tools for quantitative trading; 3. Blockchain and its applications in finance; 4. Regulatory technology. It is about how the technologies can help the market regulators to better regulate the markets; 5. Precision marketing; 6. Risk management with big data; 6. Financial knowledge graphs.

Volunteer students will choose papers from a recommended list by the lecturer and give presentations to get bonus points.

10 for guest speakers:

Tentative speaker information:

Company	Job Title	Topic
IBM Research IBM 研究院	Research Scientist 研究科学家	Blockchain and its applications
Industrial Bank 兴业银行	Investment manager 投资经理	Operations research and asset management

Bank of Communications 交通银行	Data Scientist 信用卡中心数据科学家	Precision marketing and risk management
A finance regulator 某金融监管单位	Manager 经理	Quantitative trading and market regulating
A major financial information provider 某主流金融数据供应商	Director 技术总监	Financial data service and financial news analysis
China UnionPay 中国银联电子支付研究院	Director 主管	Payment technology and anti-money laundering
A hedge fund 某对冲基金	Quant	Quantitative trading
A finance regulator 某金融监管单位	Manager 技术经理	Regtech
SSE INFONET 上证所信息网络有限公司	Director 技术总监	Financial data service and system architect
Bank of Shanghai 上海银行	Senior Executive 信息技术部高级主管	AI application in banks.

2 for project proposals, presentations and discussions:

A course project related to data science and Fintech will be announced early in the se mester. Students will team up for the course project. The students will be grouped in to teams, with each team having no more than 3 members. Early in the semester, eac h team will submit project proposals and give presentations during class. The teachin g group will give feedbacks to the teams and score the reports and presentations.

2 for project interim reports, presentations and discussions:

Around mid-term, each team will submit interim reports and give presentations durin g class. The teaching group will give feedbacks to the teams and score the reports an d presentations.

2 for project presentations:

In week 15, each team will submit final project reports and give presentations during class. The teaching group will give feedbacks to the teams and score the reports and presentations.

Through the semester, office hours of the professor and TAs will be arranged to ans wer questions and help the students with the projects.

《高阶数字信号处理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE254
课程名称:	高阶数字信号处理	英文名称:	Advanced Digital Signal Processing
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers advanced signal processing methods, including stochastic signal processing fundamentals, adaptive signal processing, array signal processing, and adaptive array signal processing. The objective of this course is for the student to get theoretical understanding of advance signal processing methods as well as hand-on Matlab experience.

三、教学内容、教学方式和学时安排

Weeks	Lectures 1	Lectures 2
1	Course introduction + Stochastic signal processing	Stochastic signal processing
2	Exercises + Labs	Stochastic signal processing
3	Stochastic signal processing	Exercises + Labs
4	Adaptive signal processing	Adaptive signal processing
5	Exercises + Labs	Adaptive signal processing
6	Adaptive signal processing	Exercises + Labs
7	Array signal processing	Array signal processing
8	Exercises + Labs	Array signal processing

9	Array signal processing	Exercises + Labs
10	Adaptive array signal processing	Adaptive array signal processing
11	Exercises + Labs	Adaptive array signal processing
12	Adaptive array signal processing	Exercises + Labs

《集成电路设计流程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290V
课程名称:	集成电路设计流程	英文名称:	IC Design Flow
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

“Flow of IC Design” is a comprehensive course covering the entire procedures which are required in the IC design flow. These procedures are divided into 3 major stages

(1) Specification definition including architecture plan, technology decision, IP selection, etc

(2) IC design including front-end design and back-end design

(2-1) Front-end design: This is the main part of this course. Digital design flow is adopted to explain the major procedures. The course will introduce the coding style of HDL, test bench, functional/ pre-/ post-simulation, FPGA verification, netlist generation, etc

(2-2) Back-end design: This part explains the procedures from netlist to GDS, and the concept of timing is emphasized. The concept of clock tree, APR, DRC, LVS, etc will be introduced.

(3) IC manufacture including the procedures after tape out, covering foundry process, packaging, testing, etc.

Besides the above items, market-related information will also be shared for better view in IC design industry.

The purpose of this course is to make students be familiar with the terminologies, tools, procedures and techniques which will be encountered in the career life. This is a pre-course for the job preparation.

三、教学内容、教学方式和学时安排

This course is distributed into 16-week 2-hour class as below:

W01: Definition of IC design flow, IC specification introduction

W02: IC architecture planning, IP introduction & selection

W03: HDL coding : problems easy to be made

W04: Debug: test bench and RTL simulation

W05: FPGA verification: netlist generation and environment setup

W06: Library and memory, DFT

W07: Netlist synthesis and SDF

W08: Timing and pre-simulation

W09: APR: layout concept

W10: Analog circuits design

W11: Post-simulation & SDF generation

W12: DRC, LVS, tape out sign-off

W13: Foundry technology introduction

W14: Fabrication

W15: Test patterns, CP/FT testing

W16: Packaging, Shipment

This is the outline for the teaching scope of each week.

《离散数学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI120
课程名称:	离散数学	英文名称:	Discrete Mathematics
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程旨在介绍计算机科学中常见离散结构的基本概念、理论、方法及应用。
开设本课程的目的有二：
培养计算机及相关专业本科生的数学成熟度使得他们能够理解并设计数学证明；
为计算机专业相关后续课程提供坚实的数学基础。
本课程将覆盖离散数学众多重要分支，例如基本的集合论，数理逻辑（证明技术、数学归纳），数论（模算术、同余方程），组合计数（基本计数原理、递推关系、生成函数），图论（图和树）和布尔代数（布尔函数）等。本课程将为诸多后续课程提供坚实的数学基础。数理逻辑是软件工程、编程语言、人工智能和数据库理论的主要基础。数学归纳以及一般的证明技术是计算理论、编译器原理、形式文法等课程的重要工具。组合计数在计算机科学中常被用来分析算法的复杂度并得到其公式表示。数论及相关算法在现代密码学中起着中心作用。集合、图、树等离散结构是软件工程的基本工具。 布尔代数主要应用在电路设计中。

三、教学内容、教学方式和学时安排

课堂教学内容	**教学进度和学时安排**	**教学方式**
集合、函数、序列、求和、矩阵、算法、函数增长速度、复杂度	第一周	
命题逻辑	第二周	
谓词、量词	第三周	
推理规则、证明	第四周	
数学归纳	第五周	
基本计数原理、鸽笼原理、排列和组合	第六周	

二项式系数及相关恒等式、广义置换和组合	第七周	
递推关系	第八周	
生成函数、容斥原理	第九周	
整除、模算术、整数表示与算法、素数、最大公因子	第十周	
同余方程及其应用	第十一周	
图的基本概念、图的同构	第十二周	
图的连通性、欧拉路径、哈密尔顿路径	第十三周	
平面图、图的染色	第十四周	
树的基本概念	第十五周	
布尔函数、逻辑门、电路的极小化	第十六周	
期末考试	第十七周	

《计算机体系结构 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS110
课程名称:	计算机体系结构 I	英文名称:	Computer Architecture I
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

Computer Architecture is mandatory for all Computer Science majors. It teaches the internal organization and operation of digital computers. The class covers C and assembly language programming, memory management, how higher level programs are translated into machine lang

uage, computer organization, computer logic and CPU design, caches, performance measurement, parallelism, warehouse scale computing, and related topics.
There are four hours of lecture and one-hour discussion per week.
For CS students, the Engineering Design practicum is attached to the Computer Architecture course, see its syllabus for more details on that.

三、教学内容、教学方式和学时安排

The topics are listed below – some topics will take up to three lectures, others only o ne:

1. C Programming
2. Assembler Programming (MIPS)
3. Compiling, Assembling, Linking, Loading
4. Synchronous Digital Systems
5. CPU design
6. Pipelining
7. Caches
8. Floating Point Arithmetic
9. Parallelism (SSE & OpenMP)
10. Warehouse-Scale Computing (MapReduce)
11. Operating Systems, Interrupts, IO, DMA
12. Virtual Memory
13. Networking
14. Dependability and RAID

Evaluation

1. Homework assignments: the objective is to familiarize you with the material and exercise your programming and circuit design skills. Grading: gradebot & manual grading.
2. Discussions: There will be one discussion session per week.
3. Labs: Show your TA that you know how to perform certain tasks and answer some questions to get checked off on your lab session.
4. Exams and quizzes:
    - Two midterm exams and one final exam. Notify the instructor immedi ately if you miss an exam due to an unforeseeable event and submit a note from your physician in case of illness.
    - Quizzes may be held in-class and will not be announced. There won't be any makeup quizzes. Quiz scores may be used for rounding to the nearest letter grade.
5. Effort: you are expected to spend approximately 13 to 16 hours per week on t his course, broken down as follows:
    - 4 hours of lecture
    - 2 hours of discussion
    - 3-4 hours of reading (book and notes)

- 2-3 hours of homework
- 2-3 for labs

Late Policy: Slip Days

You can use slip days for homework and projects. In total you have 3 slip days. Ever y day your homework or project is late (even by just a minute) one slip day gets dedu cted. Once you have used all your slip days you will get a 33% deduction per day an d thus will receive no points after 3 days – per homework or project.

Academic Integrity

Please carefully read and understand the policies below and ask the instructor if you have any questions.

- All engineering design projects will be done with a partner.
- All projects you turn in must be the work of your team and your team alone.
- Partner teams are **not allowed** to work with other partner teams on projects.
- You are encouraged to discuss general concepts with other students – especia lly on piazza. It is best to discuss questions specific to homework with the **T As** during the office hours or labs or on piazza.
- All homework are your own work.
- Non-exhaustive implications of the "all homework are your own work" rul e:
  - It is **not** acceptable to show your code to other students or to look at o ther student's code.
  - It is **not** acceptable to copy solutions from other students.
  - It is **not** acceptable to copy (or start your) solutions from the Internet.
  - It is **not** acceptable to use public websites like GitHub to obtain soluti ons or to store your code.
  - You must **secure access** to your computer at all times you are not clos e to it (i.e. prevent others to access your code).
  - You must keep your passwords **secure** – nobody else can know them.
  - It is **not** acceptable to share your private keys (i.e. for gradebot) with anybody else.
- We have tools and methods for detecting this. You **will** be caught, and the pe nalties **will** be severe!
- Both the giver and the receiver of code are equally responsible and suffer **equ al penalties:** failure of the course.

《计算理论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS141

课程名称:	计算理论	英文名称:	Theory of Computation
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course is an introduction to the foundation of computation, and aims at answering some of the most fundamental questions in computer science: What is an algorithm? What can and cannot be computed at all? What can and cannot be computed efficiently? The topics covered include set theory and countability, formal languages, finite automata and regular languages, pushdown automata and context-free languages, Turing machines, undecidability, P and NP, NP-completeness. Warning: This is a rigorous mathematical course with emphasis on theorems and proofs, and is very different from most other CS courses.

三、教学内容、教学方式和学时安排

WEEK	DATES	MONDAY	WEDNESDAY	HW&PROJECTS
1		Course Introduction Sets, Relations, and Functions	Languages and Regular Expressions	
2		Languages and Regular Expressions	Countability and uncountability Deterministic Finite Automata	
3		Nondeterministic Finite Automata	DFA = NFA = regular expression	
4		Properties of Regular Languages	The Pumping Theorem for regular languages	HW 1: Covers lectures 1-7
5		Context=free grammars & context-free languages	Context=free grammars & context-free languages	
6		Pushdown automata	Pushdown automata = Context-free languages	
7		Closure Properties of CFLs	The Pumping Theorem for CFLs	HW 2: Covers lectures 7-14
8		Q & A for midterm	Turing Machines	
9		Computing with Turing Machines	Computing with Turing Machines	
10		Extensions of TMs; the Church-Turing Thesis	Extensions of TMs; the Church-Turing Thesis	

		(Omit: Random Access TM)	(Omit: Random Access TM)	
11		Closure Properties of R. and R.E. Languages	Universal Turing Machines	HW 3: Covers lectures 16-21
12		The halting problem	Undecidable problems (Omit: Rice's theorem)	
13		Undecidable problems (Omit: Rice's theorem)	Tiling Problem	
14		P and NP·	P and NP·	
15		NP-completeness	NP-completeness	HW 4: Covers lectures 22-27
16		No lecture. Q&A Session	Q&A Session	

《计算机图形学 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS171
课程名称:	计算机图形学 I	英文名称:	Computer Graphics I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course provides fundamental introduction to computer graphics as well as some state-of-the-art computer graphics techniques. Starting from the basic 2D computer graphics, the course mainly focuses on 3D computer graphics: projection, geometrical modeling and transformation, graphical rendering, sampling and antialiasing, computational imaging, scientific visualization as well as computer animation. The students will try to learn the basic algorithms in computer graphics, the programming skills for producing 3D images, as well as creating graphics-based animations. In order to achieve these goals, the students need to finish homeworks and projects, which are designed to be practical from easy to more difficult ones.

三、教学内容、教学方式和学时安排

WEEK	DATES	MONDAY	WEDNESDAY	HW&PROJECTS
1		Introduction	The first graphics program	
2		Coordinate spaces and transforms	Projection and rasterization	HW1 out

3		Geometric representation	Geometric modeling	
4		Geometric queries	Ray tracing basics	HW1 in, HW2 out
5		Ray-object intersection	Radiometry and camera	
6		Numerical integration	Rendering equation and global illumination	HW2 in, HW3 out
7		Advanced sampling and rendering	Midterm	
8		High performance ray tracing	Theory of color	
9		Fundamentals on image processing	Light fields and computational cameras	HW3 in, HW 4 out
10		Volume rendering and scientific visualization	Scattering	
11		Computer animation	Key-framing, deformation and motion capture	
12		Physically-based animation and PDE	Rigid body simulation I	HW4 in, Project out
13		Rigid body simulation II	Soft-body simulation I	
14		Soft-body simulation II	Fluid Simulation I	
15		Fluid Simulation II	Research on computer graphics	

《计算机安全 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS151
课程名称:	计算机安全 I	英文名称:	Computer Security I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces principles, mechanisms, and implementations of computer security.
You will learn how hackers attack systems, how to defend against the attacks, and how to design systems to withstand the attacks.

三、教学内容、教学方式和学时安排

Topics include:
Security principles
Security Mechanisms
– Cryptography: symmetric key, public key, PKI, key management
– Authentication: password, challenge/response, cryptographic protocols
– Access control: access control list, capabilities, theories
– Network security: security mechanisms on the Internet, frewall, intrusion detection
– Confnement: isolation, covert channels
– Security policies
Practical security challenges
– Software vulnerabilities and secure programming.
– Web security.
– Mobile security.
Other topics as time permits and according to student interest.

《优化与机器学习》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI151
课程名称:	优化与机器学习	英文名称:	Optimization and Machine Learning
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course provides a broad introduction to machine learning, statistical learning and deep learning, with particular emphasis on learning models, optimization algorithms and statistical analysis. Topics include: supervised learning (e.g., generative learning, parametric/nonparametric learning, regression, classification, support vector machines, neural networks); unsupervised learning (e.g., clustering, dimensionality reduction, kernel methods, density estimation); statistical learning theory (bias/variance tradeoffs; VC theory; large margins); reinforcement learning and adaptive control. This course will also introduce optimization methods (e.g., gradient methods, proximal methods, ADMM, quasi-Newton methods, as well as large-scale numerical linear algebra) that are suitable for large-scale problems arising in machine learning applications.

三、教学内容、教学方式和学时安排

1. Supervised learning

(a) Regression: low-dimensional, ridge regression, lasso

(b) Classification: linear, logistic

(c) Support vector machine
(d) Neural networks and deep learning

2. Statistical learning theory

(a) Max likelihood estimation, bias and variance tradeoffs, basic Bayes

(b) Function spaces, concentration of measure, minimax theory

3. Unsupervised learning

(a) Density estimation
(b) Clustering: k-means, mixtures, density clustering, spectral clustering

(c) Generative adversarial networks

4. Reinforcement learning and control

(a) Markov decision process, Bellman equations (b) Value iteration and policy iterati on

(c) Q-learning, value function approximation

5. Large-scale optimization methods

(a) Basics on convex optimization
(b) Gradient and subgradient methods, stochastic gradient methods

(c) Proximal methods, duel methods and ADMM
(d) Large-scale numerical linear algebra: conjugate gradient, power methods, Lanczo s methods

《凸优化》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI251
课程名称:	凸优化	英文名称:	Convex Optimization
学 分:	4	学 时:	64

授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

The focus of this course is theory and algorithms for convex optimization (though we also may touch upon nonconvex optimization problems at some points), with particular emphasis on problems that arise in data science and machine learning. Our goal is to gain a fundamental understanding of convex analysis, modeling and approximation, in addition with convergence rates, complexity and scaling behavior of various algorithms, including both first-order and second-order methods, as well as both deterministic and randomized algorithms. Upon completing the course, students should have the capability of unveiling the hidden convexity of problems by appropriate manipulations, characterizing the solutions either analytically or algorithmically, designing and implementing efficient algorithms, followed by statistical analysis.

三、教学内容、教学方式和学时安排

Topics to be covered include:

1. Theory I - Fundamentals: convex sets, functions, and problems
2. Theory II - Optimality and duality: duality, KKT conditions, disciplined convex programs
3. Algorithm I - First-order methods: gradient and subgradient methods, proximal methods, dual methods, ADMM, Frank-Wolfe method, large-scale numerical linear algebra.
4. Algorithms II - Second-order methods: Newton’s method, barrier method, primal-dual interior point methods, quasi-Newton method
5. Algorithms III - Randomized methods: stochastic gradient methods, sketching methods
6. Data science applications: 1) convex geometry: phase transitions; 2) global geometry: saddle point characterization; 3) local geometry: basin of attraction; 4) low-dimensional structured models, deep learning models, missing data models.

《计算机视觉 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS272H
课程名称:	计算机视觉 II	英文名称:	Computer Vision II
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will cover the recent advances of computer vision tasks.

三、教学内容、教学方式和学时安排

1. The overall picture of object recognition (0.5 week)

Line 1: From computer vision perspective:

Take image understanding as an example and discuss the state-of-the-art technology for computer vision, and extend it to videos. This course will cover the following 6 parts, including:

Saliency detection (unsupervised saliency detection/salient object discovery) segmentation (unsupervised image segmentation) object detection (face detection/general object detection, supervised methods) object recognition (face recognition/general image classification, supervised methods) object identification ((unsupervised) content based image retrieval/(supervised)face verification)video processing (tracking/event classification(supervised))

Line 2: From machine learning perspective

Machine learning: unsupervised learning methods to supervised learning methods. For unsupervised methods, it will cover clustering methods, sparse representation, low-rank, etc. For supervised methods, it will cover SVM/Softmax/CNN

2: Saliency detection (1 week)

2.1 Definition of saliency map/salient object discovery and a survey of image saliency detection.

2.2 Saliency detection techniques.

Top-down methods and bottom-up methods

2.3 Application of saliency detection:

Content-based image resizing, object proposals for object detect ion

3: Image segmentation (1.5 weeks).

3.1 Definition of image segmentation and survey of image segmentati on.

3.2 Some representative image segmentation methods: graph cuts, Min imum description length, Active contour model.

3.3 Image co-segmentation

4: object detection (2 weeks)

4.1 A survey of face detection.

4.2 Some representative face detection methods

SVM

Boosting

Deformable Part Based Model.

4.2 General object detection

5: Object recognition (4 weeks)

5.1 face recognition (2 weeks)

Subspace based method

Sparse representation based method

DNN based method

5.2 general object recognition(2weeks)

Conventional image representation

Deep neural networks based image representation

6: Object Identification (2weeks)

6.1 Face verification

6.2 CBIR

Hashing

7 Video processing(2 weeks)

7.1 tracking

7.2 motion representation

7.3 video representation

Spatial -temporal features for video representation

Deep neural networks based feature for video representation.

7.4 video classification

《数字通信》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE240
课程名称:	数字通信	英文名称:	Digital Communications
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers the fundamental system aspects of digital communication. The purpose of this course is to understand modern systems and the corresponding simplified models in an intuitive yet precise way. The course content includes, but is not limited to, data compression, signal modulation, channel modeling, principles of detection, coding, and decoding.
The course gives an overview of the designs of digital communication systems. We explain the mathematical foundation of decomposing the systems into separately designed source codes and channel codes. We introduce the principles and some commonly used algorithms in each component, to convert continuous time waveforms into bits, and vice versa. We give a comprehensive introduction to the basics of information theory, a rather thorough treatment of Fourier transforms and the sampling theorem, and an overview of the use of vector spaces in signal processing.

三、教学内容、教学方式和学时安排

Class week	Topic	Requirements
1	Introduction, discrete source coding	
2	Memoryless sources, prefix codes, entropy	
3	Quantization	
4	Measure, Fourier series, and Fourier transforms	
5	Discrete-time Fourier transforms, sampling theorem	
6	Signal space, projection theorem, modulation	
7	Nyquist theory, pulse amplitude modulation (PAM), quadrature amplitude modulation (QAM)	
8	Random processes, Jointly Gaussian random vectors, white Gaussian noise	
9	Detection for random vectors and processes	Mid-term
10	M-ary detection, and coding	
11	Baseband detection, complex Gaussian processes	
12	Introduction of wireless communication	

13	Doppler spread, time spread, coherence time, coherence frequency	
14	Discrete-time baseband models for wireless channels	
15	Detection for flat Rayleigh fading channels, rake receivers	
16	Code division multiple access, review	Final exam

《数字集成电路 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE213
课程名称:	数字集成电路 II	英文名称:	Digital Integrated Circuits II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course aims to convey a knowledge of advanced concepts of circuit design for digital VLSI components in state of the art MOS technologies. Emphasis is on the circuit design, optimization, and layout of either very high speed, high density or low power circuits for use in applications such as microprocessors, signal and multimedia processors, memory and periphery. Special attention will devoted to the most important challenges facing digital circuit designers today and in the coming decade, being the impact of scaling, deep submicron effects, interconnect, signal integrity, power consumption, and timing.

三、教学内容、教学方式和学时安排

In this section, please list topics and schedule in detail.

1. Introduction
2. Scaling issues
3. Technologies
4. Transistor models

5. Delay models
6. Variability
7. SRAM
8. ECC
9. Timing
10. Latches

《光电器件 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE222
课程名称:	光电器件 II	英文名称:	Optoelectronic Devices II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程将介绍用于高速光通信，数据中心和激光雷达等领域的半导体光电器件。其中包括用作相干光源的半导体激光器，调制光束的激光调制器，和用于光探测的光电探测器。这门课程将聚焦在半导体光电器件的物理，静态和动态特性。

三、教学内容、教学方式和学时安排

本课程的参考书目和幻灯片为英文，讲授语言为中文。课程的大纲如下：

半导体基础知识

L1-L4: 半导体，半导体化合物，和异质结

L5-L10: 半导体光学特性

Part I 半导体激光器

L11-L14: 发光二极管

L15-L18: 光波导与光学腔

L19-L22: 激光静态特性

L22-L28 激光动态特性

Part II 激光调制器

L29-L32: 调制器物理特性

L33-L36: 光电调制器

L37-L40: 光吸收调制器

Part III 光电探测器

L41-L44: 探测器物理特性

L45-L48: p-n 型探测器

L49-L52: p-i-n 型探测器

L53-L56: 雪崩光电探测器

实验课

L57-L64: 半导体激光器实验

期末考试

《模拟集成电路 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE212
课程名称:	模拟集成电路 II	英文名称:	Analog Integrated Circuits II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

这门课程涉及到模拟集成电路设计的多方面内容，包括 CMOS 工艺和器件的模型，噪声模型和分析，基本的模拟电路模块比如单级放大器，电流镜，多级运算放大器设计，反馈与频率补偿，比较器，带隙基准等。这门课程还包括若干模拟电路子系统的设计，包括开关电容电路，锁相环和数模/模数转换器，以

及超声成像系统的模拟前端电路系统介绍。除了作业，还将进行多次的上机实践并完成三个电路模块的设计与仿真，并提交项目报告。

三、教学内容、教学方式和学时安排

周	*授课内容*	*作业*
1	课程介绍	第一次作业
2	CMOS 工艺与器件模型	
3	噪声分析	第二次作业
4	放大器与电流镜电路	
5	运算放大器	第三次作业
6	反馈与频率补偿	
7	比较器，带隙基准	第四次作业
8	开关电容电路	第一个项目报告
9	振荡器	第五次作业
10	锁相环	期中考试
11	非线性与匹配补偿	
12	数模/模数转换器，超声成像系统前端模拟电路介绍	
13-16	完成项目报告，准备期末考试	第二个项目报告 第三个项目报告 附加项目报告 期末考试

《计算机体系结构 I 课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS110P
课程名称:	计算机体系结构 I 课程设计	英文名称:	Computer Architecture I Project
学 分:	2	学 时:	96
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

For your engineering design course the CS students of SIST will work on 4 to 5 big projects related to Computer Architecture. You will spend about one day per week on this project - additionally to the Computer Architecture lecture! The projects are done in groups of two persons. The projects will be evaluated according to the task descriptions. You can get help regarding your projects during the office hours and during the labs. You will get one total grade which is combined from your scores of the Computer Architecture course and the Engineering Design course.

三、教学内容、教学方式和学时安排

Late Policy: Slip Days

You can use slip days for homework and projects. In total you have 3 slip days. Every day your homework or project is late (even by just a minute) one slip day gets deducted. Once you have used all your slip days you will get a 33% deduction per day and thus will receive no points after 3 days – per homework or project.

Academic Integrity

Please carefully read and understand the policies below and ask the instructor if you have any questions.

- All engineering design projects will be done with a partner.
- All projects you turn in must be the work of your team and your team alone.
- Partner teams are **not allowed** to work with other partner teams on projects.
- You are encouraged to discuss general concepts with other students – especially on piazza. It is best to discuss questions specific to homework with the **TAs** during the office hours or labs or on piazza.
- All homework are your own work.
- Non-exhaustive implications of the “all homework are your own work” rule:

    - It is **not** acceptable to show your code to other students or to look at o ther student's code.
    - It is **not** acceptable to copy solutions from other students.
    - It is **not** acceptable to copy (or start your) solutions from the Internet.
    - It is **not** acceptable to use public websites like GitHub to obtain soluti ons or to store your code.
    - You must **secure access** to your computer at all times you are not clos e to it (i.e. prevent others to access your code).
    - You must keep your passwords **secure** – nobody else can know them.
    - It is **not** acceptable to share your private keys (i.e. for gradebot) with anybody else.
- We have tools and methods for detecting this. You **will** be caught, and the pe nalties **will** be severe!
- Both the giver and the receiver of code are equally responsible and suffer **equ al penalties:** failure of the course.

《编译原理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS131
课程名称:	编译原理	英文名称:	Compilers
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

课程简介：

1. 本课程介绍编译器构造的一般原理和基本实现方法，主要介绍编译器的各个阶段：词法分析、语法分析、语义分析、中间代码生成、代码优化和目标代码生成。反映直至 20 世纪末的一些重要成果，如有关类型制导的编译思想。

2. 本课程在介绍命令式程序设计语言实现技术的同时，强调一些相关的理论知识，如形式语言和自动机理论、语法制导的定义和属性文法、类型论等。它们是计算机专业理论知识的重要一部分，在本书中结合应用来介绍这些知识，有助于学生较快领会和掌握。

3. 本课程强调形式化描述技术，并以语法制导定义作为翻译的主要描述工具。

4. 本课程强调对编译原理和技术在宏观上的理解，而不把读者的注意力分散到一些枝节的算法上，如计算开始符号集合和后继符号集合的算法，回填

技术等。作为原理性的教材，本书介绍基本的理论和方法，而不偏向于某种源语言或目标机器。
教学目的：
理论:使学生熟练掌握编译器构造的一般原理、基本实现方法及其相关理论知识。
实践：能够独立设计和开发简单语言的编译器。

课程意义：
1. 本课程能使学生对编程语言的设计和实现有深刻的理解，对和编程语言有关的理论（形式语言和自动机理论、类型论等）有所了解，对宏观上把握编程语言来说，起一个奠基的作用。
2. 对软件工程来说，编译器是一个很好的实例（基本设计、模块划分等），也是本科期间能碰到的唯一的大型例子，学生从本课程的学习也能了解到软件工程中的一些技术（如基于事件驱动的编程）。本课程所介绍的概念和技术能应用到一般的软件设计之中。
3. 大多数程序员同时是语言的设计者，虽然是一些简单的语言（如输入输出），本课程的学习有助于提高对这些语言的设计水平。
4. 编译技术在软件逆向工程、程序理解和软件安全等方面有着广泛的应用
5. 软件逆向工程：以另外一种形式创建系统同一层次的表示或者更高层次的抽象， 应用：技术仿造、软件维护。
6. 程序理解：通过分析、抽象和一般化来获取软件知识的演绎过程。（1）基于机器代码和中间代码层的理解，需要借助于反汇编和反编译技术；（2）基于源代码的理解；（3）基于语法层的理解，程序分段、程序切片和程序分析等技术就是其中的最典型代表；（4）基于程序语义层的理解，模式匹配、格局识别(plan recognition)、概念赋值（concept assigned）和概念分析(concept analysis)等都是进行语义级的软件理解和分析技术。
7. 软件安全：满足安全策略。基本安全策略：类性安全、控制流安全和内存安全。还有信息流安全。用到词法、语法和语义分析、类性系统和类性检查、控制流分析和数据流分析等。编译器将走向类型制导的编译器。

三、教学内容、教学方式和学时安排

课堂教学内容	教学进度和学时安排	教学方式
第一章 绪论 1.1 语言处理 1.2 编译器结构	第 1 周 2 学时	课堂教学、课后复习（作业）
第二章 一个简单的语法制导翻译器	第 1 周	课堂教学、复习（作业）

2.1 引言 2.2 语法定义 2.3 语法制导翻译 2.4 语法分析 2.5 简单表达式的翻译器 2.6 词法分析 2.7 符号表 2.8 中间代码生成	2 学时 第 2 周 2 学时 总计 4 学时	
第 3 章 词法分析 3.1 词法分析器的作用 3.2 输入缓冲 3.4 词法单元的识别 3.5 词法分析器生成工具 Lex 3.6 有穷自动机 3.7 从正则表达式到自动机 3.8 词法分析器生成工具的设计 3.9 基于 DFA 的模式匹配器的优化	第 2 周 2 学时 第 3 周 4 学时 第 4 周 4 学时 第 5 周 2 学时 总计 12 学时	课堂教学、复习（作业）、材料阅读、词法分析器项目
第 4 章 语法分析 4.1 引论 4.2 上下文无关文法 4.3 设计文法 4.4 自顶向下的语法分析 4.5 自底向上的语法分析	第 5 周 2 学时 第 6 周 4 学时 第 7 周 4 学时	课堂教学、复习（作业）、材料阅读、语法分析器项目

4.6 LR 语法分析技术介绍：简单 LR 4.7 更强大的 LR 语法分析器 4.8 使用二义性文法 4.9 语法分析器的生成工具	第 8 周 2 学时 总计 12 学时	
随堂测验	第 8 周 2 学时	**闭卷**
第 5 章 语法制导的翻译 5.1 语法制导定义 5.2 SDD 的求值顺序 5.3 语法制导翻译的应用 5.4 语法制导的翻译方案 5.5 实现 L-属性的 SDD	第 9 周 4 学时 第 10 周 2 学时	课堂教学、复习（作业）
第 6 章中间代码生成(6h) 6.1 语法树的变种 6.2 三地址代码 6.3 类型和声明 6.4 表达式的翻译 6.5 类型检查 6.6 控制流 6.7 回填 6.8 Switch 语句 6.9 过程中间代码	第 10 周 2 学时 第 11 周 4 学时	课堂教学、复习（作业）、材料阅读
随堂测验讲解	第 12 周 2 学时	

第 7 章运行时环境 7.1 存储组织 7.2 栈空间分配 7.3 栈中非局部数据访问 7.4 堆管理 7.5 内存回收简介	第 12 周 2 学时 第 13 周 2 学时	课堂教学、复习（作业）
第 8 章代码生成 8.1 代码生成器设计中的问题 8.2 目标程序 8.3 目标程序中的地址 8.4 基本块和流图 8.5 基本块优化 8.6 一个简单代码生成器 8.7 窥孔优化 8.8 寄存器分配和指派 8.9 通过树重写来选择指令	第 13 周 2 学时 第 14 周 4 学时	课堂教学、复习（作业）、项目代码生成器
第 9 章 优化 9.1 优化的主要来源 9.2 数据流分析介绍 9.3 数据流分析基础 9.4 常量传播 9.5 部分冗余消除 9.6 流图中的循环	第 15 周 4 学时 第 16 周 2 学时	课堂教学、复习（作业）、材料阅读

9.7 基于区域的分析 9.8 符号分析		
	第 16 周 2 学时	
期末考试	第 17 周 2 学时	闭卷

《人工智能》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS281H
课程名称:	人工智能	英文名称:	Artificial Intelligence
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Topics in artificial intelligence, including: search, game playing, constraint satisfaction problems, knowledge representation and reasoning, uncertain knowledge and reasoning, decision theory, introduction to machine learning, introduction to natural language processing, etc.

三、教学内容、教学方式和学时安排

Introduction	Week 1
Search	Week 1
Game playing	Week 2
Constraint satisfaction problems	Week 3

Propositional logic	Week 4
First-order predicate logic	Week 4-5
Semantic web	Week 5
Probabilistic graphical models	Week 6-7
Probabilistic temporal models	Week 8
Decision theory	Week 8
Probabilistic logics	Week 9
Introduction to machine learning	Week 10
Introduction to natural language processing	Week 11
AI philosophy	Week 12

《信息科学技术导论课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100P
课程名称:	信息科学技术导论课程设计	英文名称:	Information Science and Technology Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course consists of four components.

- Programming. This section is for students with good programming skills. We will introduce advanced topics in developing fast, memory safe, thread safe programs using Rust. Topics include:

- Ownership, borrowing, and lifetime
- Generics and traits
- Closures
- Concurrent programming

- Functional programming

- Robotics. This part of the course gives a short overview of some important topics within this area, concentrating on algorithms and software. First robotics in general will be introduced, as well as the problem of how to write software for robotics. Then special lectures on specific topics will be presented: Mapping, Control, Optimization, Computer Vision, Artificial Intelligence (AI) and Machine Learning. The four-week robotics project starts with an introduction to and a tutorial on the Robot Operating System and the robot simulation software. Then the actual project topic is introduced. The implementation phase of the project is two weeks long, followed by final experiments with real robots.
- Signal and Systems. Provide an overview of the following areas:

- Signal Processing gives an overview of various signal processing techniques playing important roles in our everyday life.
- Communication touches on hot topics in several generations of wireless communications,including 2G, 3G, and 4G, and covers the fundamentals behind these everevolving technologies.
- Information teaches the basic theory behind information and helps the students understand the problem, such as how we can reliably communicate through a non-reliable link.
- Networking helps students understand the structure and rationale of our current networking, which is the “core” of our current internet life.
- Control introduces the rich filed of control theory, which builds up the foundation for our modern automation.

- Electronics. Provide an entry level overview of the following areas: 1) Circuits Theory; 2) Devices and Sensors; 3) Analog Circuits; 4) Radio Frequency Circuits; 5) Digital Circuits; 6) Electronic Design Automation; 7) Power Electronics; 8) Power Systems and Renewable Energies.

There are labs based on projects and the homework is challenging.

三、教学内容、教学方式和学时安排

This course consists of four components.

Programming. This section assumes no programming skills. We will introduce basic concepts in software and teach how to program Python. Topics include:

- Data representation

- Names, values, and types

- Type checking and inference

- Functions and parameters

- Composite data types

- Control structures

- Object-oriented techniques

- Functional programming techniques

- Debugging and testing.

Robotics. This part of the course gives a short overview of some important topics wi thin this area, concentrating on algorithms and software. First robotics in general will be introduced, as well as the problem of how to write software for robotics. Then sp ecial lectures on specific topics will be presented: Mapping, Control, Optimization, C omputer Vision, Artificial Intelligence (AI) and Machine Learning. The four-week ro botics project starts with an introduction to and a tutorial on the Robot Operating Sys tem and the robot simulation software. Then the actual project topic is introduced. Th e implementation phase of the project is two weeks long, followed by final experime nts with real robots.

Signal and Systems. Provide an overview of the following areas:

- Signal Processing gives an overview of various signal processing tec hniques playing important roles in our everyday life.

– **Communication** touches on hot topics in several generations of wireless commu nications,

including 2G, 3G, and 4G, and covers the fundamentals behind these everevolving te chnologies.

- Information teaches the basic theory behind information and helps the students understand the problem, such as how we can reliably communicate through a non-re liable link.

- Networking helps students understand the structure and rationale of our current networking, which is the “core” of our current internet life.

- Control introduces the rich filed of control theory, which builds up the foundati on for our modern automation.

Electronics. Provide an entry level overview of the following areas: 1) Circuits The ory; 2) Devices and Sensors; 3) Analog Circuits; 4) Radio Frequency Circuits; 5) Dig

ital Circuits; 6) Electronic Design Automation; 7) Power Electronics; 8) Power Systems and Renewable Energies.

There are labs based on projects and the homework is challenging.

III. Course Schedule

《无线通信》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE241G
课程名称:	无线通信	英文名称:	Wireless Communcations
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

在当今飞速发展的信息时代，数字通信已成为信息传输的重要手段。数字通信的新设备和新技术在不断涌现，并迅速应用到通信的各个领域，带动了信息科学技术的迅速发展。在信息化社会中，人们越来越离不开数字通信这种手段，也越来越期望了解和掌握数字通信技术。

《数字通信》这门课程就是在这种背景下，为满足人们掌握数字通信技术的需要，面向通信与信息系统专业开设的专业基础课程。这门课程以数字通信技术为主线，对确定性与随机性的信号分析、数字调制方法、载波和符号同步技术、信道编解码技术、信道和噪声的影响、多址技术以及多天线技术等进行全面系统的讲解，特别介绍了数字通信系统及一些数字通信技术的新的应用。这门课程既适应了当前通信领域发展的现状，又反映了这一领域发展的最新进展，同时注重与实际应用的结合。课程中，将穿插进行数字通信技术发展过程中的最新进展综述性介绍。

通过本门课程的学习，可以使同学们比较完整和系统地掌握主要的数字通信技术，并能将所学知识应用于实际中，掌握分析和解决实际问题的能力。

三、教学内容、教学方式和学时安排

教学内容	**学时安排**	**教学方式**
数字通信概述	1	课堂讲授 PPT

确定性与随机性的信号分析	1	课堂讲授 PPT
数字调制方法	1	课堂讲授 PPT
AWGN 信道的最佳接收	2	课堂讲授 PPT
载波和符号同步	1	课堂讲授 PPT
信息论基础	1	课堂讲授 PPT
线性分组码	1	课堂讲授 PPT
基于网格和图的编码	1	课堂讲授 PPT
带限信道的数字通信	1	课堂讲授 PPT
自适应均衡	1	课堂讲授 PPT
多信道和多载波系统	1	课堂讲授 PPT
数字通信中的扩频信号	1	课堂讲授 PPT
衰落信道的特征与信号传输	2	课堂讲授 PPT
衰落信道的容量与编码	2	课堂讲授 PPT
多天线系统	2	课堂讲授 PPT
多用户通信	2	课堂讲授 PPT
最新数字通信技术介绍	6	课堂讲授 PPT
课程综合设计	5	方案评述

《操作系统 II 课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS230P
课程名称:	操作系统 II 课程设计	英文名称:	Operating Systems II Project
学 分:	1	学 时:	48

授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The purpose of this course is to teach the design of operating systems. Topics include multiple-program systems (processes, interprocess communication, and synchronization), memory allocation (segmentation, paging), resource allocation and scheduling, file systems, basic networking (packet switching, file control, reliability), security, and privacy.

三、教学内容、教学方式和学时安排

Lectures, discussions, labs, projects, and presentations.

《Systems programming with Rust》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS290B
课程名称:	Systems programming with Rust	英文名称:	Systems Programming with Rust
学 分:	2	学 时:	32
授课对象:		授课语言:	
先修课程:			

二、课程简介和教学目的

Rust is a systems programming language focused on three goals: safety, speed, and concurrency.
It is used to write an operating system, parallel browser engine, HTTP client and server,
and more. It was used to teach operating systems. It won the first place for Most Loved Programming
Language of 2016 in the Stack Overflow Developer Survey. On the other hand, Rust

has a steep learning curve, because it borrowed good features from s everal other languages.

三、教学内容、教学方式和学时安排

We will focus on the following key topics:
Ownership, borrowing, and lifetimes.
Generics and traits.
Closures.
Concurrency.
Standard library.

《计算机程序语言和数据结构》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS101H
课程名称:	计算机程序语言和数据结构	英文名称:	Programming Languages and Data Structures
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces mathematical modeling of computational proble ms. It covers basic data structures and algorithms for solving these problems, and performance measurement and anal- ysis techniques for these problems.

三、教学内容、教学方式和学时安排

Topics include:
Algorithm design and analysis: performance measurement, asymptotic notation.
Elementary data structures: linked lists, stacks, queues.
Trees: binary search trees, balanced trees, B-trees, disjoint sets.
Sorting: merge, heap, and quick sort.
Graph algorithms: breadth-first search, depth-first search, topological sort, minimu

m spanning trees, single-source shortest paths.
Hashing: hash functions and tables.

《网络编码理论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290A
课程名称:	网络编码理论	英文名称:	Network Coding Theory
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

网络编码是本世纪诞生的一个网络通信的新技术。当前它已经发展成一个重要的而且非常热的研究领域。本课程的目的是为学生提供网络编码的理论研究和应用所需要的基本思想和知识。
课程学习的主要对象是单信源网络编码。课程内容包括网络编码的基本概念，单信源无圈网络的线性编码，单信源有圈网络的卷积编码。如果时间允许我们将向学生简介几个当前活跃的研究方向（例如，多信源网络编码，网络纠错编码，网络安全编码，网络编码在分布式储存上的应用等）。

三、教学内容、教学方式和学时安排

授课时间共 30 小时

1，信息流的定律：网络编码的基本概念， 6 小时。

2，单信源无圈网络的线性编码，16 小时

3，单信源有圈网络的卷积编码，6 小时

4，复习，答疑和学科前沿进展简介，2 小时

5，学生讲解自己组的 project 2 小时

《有限元分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI212
课程名称:	有限元分析	英文名称:	Finite Element Analysis
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

作为数学工具，有限元方法在数学学科与其它科学技术领域都有着广泛的应用。在已掌握本科阶段高等数学与线性代数知识的基础上，学生通过本课程的学习可以进一步深化求解偏微分方程的相关知识，培养抽象思维能力、科学计算能力、科学研究能力，从而提高解决实际问题的能力。

三、教学内容、教学方式和学时安排

本课程主要讲授以下内容:

1. Review of essential functional analysis (4 Lectures)

2. Polynomial approximations (4 Lectures)

3. Finite element methods for the Poisson equation (8 Lectures)

4. Finite element methods for the Stokes equations (8 Lectures)

5. Advanced methods for the Navier-Stokes equations (8 Lectures)

教学方法：预习，课堂教学，课后复习与作业，文献阅读以及讨论。

《人工智能》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS281
课程名称:	人工智能	英文名称:	Artificial Intelligence
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Topics in artificial intelligence, including: search, constraint satisfaction problems, game, logic, probabilistic graphical models, probabilistic temporal models, Markov decision processes, reinforcement learning, introduction to machine learning, introduction to natural language processing, AI philosophy, etc.

三、教学内容、教学方式和学时安排

Introduction	Week 1
Search	Week 1
Constraint satisfaction problems	Week 2
Game	Week 3
Symbolic logic	Week 4-5
Semantic web	Week 5
Probabilistic graphical models	Week 5-7
Probabilistic logics	Week 7
Probabilistic temporal models	Week 8
Project proposal presentations	Week 9
Reinforcement learning	Week 10-11
Introduction to machine learning	Week 12-13
Introduction to natural language processing	Week 13-14
Project final presentation	Week 15-16
AI philosophy	Week 16

《电力系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE271
课程名称:	电力系统	英文名称:	Power System
学 分:	4	学 时:	64
授课对象:	信息科学与技术学院	授课语言:	中英文

先修课程:	

二、课程简介和教学目的

本课程旨在介绍电力系统设计的基本概念，包括电力系统保护，稳定性以及控制。首先，回顾三相电力系统的背景知识，包括相量、稳态运行、对称分量法以及电力系统元件建模。而后，分析电力系统暂态过程，包括电磁暂态过程（故障分析）以及机电暂态过程（稳定性）。最后，介绍电力系统继电保护方法并将其应用于特定电力系统元件。

三、教学内容、教学方式和学时安排

本课程教学方式以课堂笔记为主，教学内容及相应学时（共 64 学时）安排如下：

1. 课程简介 （第一章，2 学时）

2. 背景知识回顾

    2.1. 基本概念（第二章，6 学时）
        相量与功率概念
        相量计算
        网络解法
        三相电力系统
        对称分量法

    2.2 电力系统模型（第三章，8 学时）
        输电/配电线路模型
        变压器模型
        标幺制系统
        发电机模型

3. 电力系统电磁暂态（第四章，12 学时）
        对称故障分析
        不对称故障分析
        故障电磁暂态
        瞬态恢复电压（TRV）
        电力系统接地

4. 电力系统机电暂态与稳定性（第十四章，16 学时）
        暂态稳定
        数值解法

等面积法则
系统稳定性

5. 电力系统继电保护（第五章，20 学时）
电流电压互感器
过电流保护继电器
差动保护继电器
过压/欠压保护
过励磁保护
距离保护继电器
纵联保护

《矩阵分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI231H
课程名称:	矩阵分析	英文名称:	Matrix Analysis
学 分:	3	学 时:	48
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

Matrix Analysis is an extension of the theory of linear equations and is one of the most important mathematical subjects that arise in the study, application and research of engineering and related sciences. The goal of this course is to introduce the foundations and main techniques of this theory at the graduate level, keeping a balance between classical and modern aspects. It is recommended that students who register at this class have had some prior experience with linear algebra, even though this is not strictly necessary.

三、教学内容、教学方式和学时安排

Algebraic structure and linear transformations of abstract vector spaces.

Matrices as coordinate representations of linear transformations.

Elementary row/column operations, rank and fundamental spaces of matrices.

Theory of determinants.

Norms and orthogonal projections. QR decomposition. Least-Squares.

Spectral theory (eigenvalues/eigenvectors).

Singular Value Decomposition.

Variational and interlacing theorems for spectra of symmetric matrices.

Robust and Generalized Principal Component Analysis.

Module theory.

《概率论与数理统计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI140
课程名称:	概率论与数理统计	英文名称:	Probability and Statistics
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程是信息学院的一门基础课，通过本课程的学习，使学生掌握概率论与数理统计的基本概念、基本理论与方法，为后续相关专业课程奠定必要的数学基础。

三、教学内容、教学方式和学时安排

本课程主要讲授以下内容:
1. Introduction to Probability
a. Events, set theory and probability
b. Basic relationships of probability
c. Conditional probability
d. Bayes' Theorem
2. Discrete Probability Distributions
a. Random variables
b. Discrete probability distribution
c. Low order statistical moments: mean and variance
d. Special distributions: Binomial distributions

3. Continuous Probability Distributions
a. Uniform Distribution
b. Normal Distribution
c. Approximation of distributions
4. Random Vectors and Large Random Samples
a. Joint distributions, covariance, correlation, independence
b. The law of large numbers
c. The central limit theorem
5. Markov Chain
6. Markov Chain Monte Carlo

《密码学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS252
课程名称:	密码学	英文名称:	Cryptography
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程是现代密码学的入门课程。 密码学的主要研究对象是保护数字信息、交易以及分布式计算的各种技术。密码学能提供主要理论基础和实用解决方案以抵御敏感信息、数据传输过程中非授权个体的侵害，其核心目标就是要保证所传输信息的机密性以及完整性。本课程将探讨对称和非对称加密技术，具体包括分组密码、对称加密方案、哈希函数、消息认证、认证加密方案、非对称加密方案、数字签名、公钥基础设施、密钥分发；本课程还将探讨上述密码技术的应用以及若干新型密码协议的构造，例如密钥共享、不经意传输、私有信息检索、安全计算以及零知识证明等。本课程将培养学习者以可证明安全的方法对各类信息安全问题作严格数学表述、求解与证明的能力。

三、教学内容、教学方式和学时安排

Week	Topic	Activities
1	Course Overview, Basic Notions in Cryptography, Brief History of Cryptography, Kerckhoff's Principle, Historical Ciphers and Their Cryptanalysis	Lecture, Homework

2	Provable Security, Basics of Finite Probability, Perfect Secrecy, Perfect Indistinguishability, One-Time Pad and its Limitations, Computational Security, IND-EAV	Lecture, Homework
3	Computational Indistinguishability, Pseudorandomness, PRG, PRG based Encryption, Stream Cipher, One-Way Function, One-Way Permutation, One-Way Function Family, Hard-Core Predicate, Goldreich-Levin Theorem,	Lecture, Homework
4	PRG from Hard-Core Predicate, PRG with Arbitrary Expansion, IND-m-EAV, CPA, IND-CPA, IND-m-CPA, PRF, PRF based Encryption, Conversions between PRF and PRG	Lecture, Homework
5	PRP, Strong PRP, PRP and Strong PRP from PRF, Modes of Stream Ciphers, Modes of Operations, Message Integrity, MAC, EUF-CMA, PRF based MAC, MAC for any messages	Lecture, Homework
6	CBC-MAC, CCA, IND-CCA, IND-m-CCA, Padding-Oracle Attacks, Encrypt then Authenticate, Hash Functions, MD Transform	Lecture, Homework
7	Hash and MAC, HMAC, Hash Function Attacks, Practical Constructions of Stream Ciphers, Practical Constructions of Block Ciphers	Lecture, Homework
8	DES, DES Attacks, DES Extensions, AES, Davies–Meyer Construction, Practical Constructions of Hash Functions, Elementary Number Theory	Lecture, Homework
9	Basic Algorithmic Algebra, Basic Group Theory, Cryptographic Hardness, Primality Test, Factoring, Discrete Logarithm, KDC, Diffie-Hellman Key Agreement	Lecture, Homework
10	Public-Key Revolution, Public-Key Encryption, Security of PKE, ElGamal Encryption	Lecture, Homework
11	RSA, RSA Attacks, RSA-OAEP, Hash-and-Sign Paradigm, Plain RSA Signature, DSA, Block Chain	Lecture, Homework
12	Advanced Topics: Oblivious Transfer, Multiparty Computation	Lecture, Homework
13	Advanced Topics: Secret Sharing, Private Information Retrieval	Lecture, Homework
14	Advanced Topics: Delegating Computation, Proof of Knowledge	Lecture, Homework
15	Review	
16	Final Exam	

《电子科技导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100E
课程名称:	电子科技导论	英文名称:	Introduction to Electrical Engineering
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course consists of six components: 1) semiconductor and devices; 2) circuits & systems; 3) communication and control; 4) optoelectronics 5) microwave; 6) power and energy.
There are labs based on projects and the homework is challenging.

三、教学内容、教学方式和学时安排

1-3 Semiconductor and device

4-7 Circuits & systems

8-11 Communication and control

12-13 Optoelectronics

14-14 microwave

15-16 Power and energy

《电子科技导论实验》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100EP
课程名称:	电子科技导论实验	英文名称:	Introduction to Electrical Engineering Lab
学 分:	1	学 时:	48

授课对象:		授课语言:	
先修课程:			

二、课程简介和教学目的

This regular lectures (SI100E) consists of six components: 1) semiconductor and devices; 2) circuits & systems; 3) communication and control; 4) optoelectronics 5) microwave; 6) power and energy. For these components, there will be field visiting or related labs.

三、教学内容、教学方式和学时安排

This regular lectures (SI100E) consists of six components: 1) semiconductor and devices; 2) circuits & systems; 3) communication and control; 4) optoelectronics 5) microwave; 6) power and energy. For these components, there will be field visiting or related labs.

《微电子器件》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE123H
课程名称:	微电子器件	英文名称:	Microelectronic Devices
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

该课程主要面向半导体器件方向的研究生或高年级本科生。课程主要涵盖了半导体微电子器件物理和设计原则，高频器件噪音分析，微波信号分析与处理，以及关于各类新型两端/三端微电子器件的介绍和研发现状。

三、教学内容、教学方式和学时安排

第一讲: 半导体物理与器件回顾（8 学时）

Lattices, Brillouin zone and symmetry, energy bands in bulk, E-k relations, Block functions, Si and GaAs, quantum confined structures, densities of states

and statistics, carrier density, p-n junction, Bipolar Junction Transistor (BJT), Metal-Oxide-Semiconductor Transistor (MOSFET)

第二讲: 半导体射频器件噪音分析（4 学时）

Thermal noise, shot noise, flicker noise, diffusion noise, impact ionization noise, noise figure

第三讲 两端微电子器件 1– 微波信号分析与处理（6 学时）

power detection, frequency conversion (signal mixing), amplitude control (RF attenuator), Phase control (phase shifter), RF switching, fundamental oscillator, harmonic generator, frequency upconverter, Parametrically induced negative resistance, Internally generated negative resistance

第四讲: 两端微电子器件 2 – Junction 高频器件（6 学时）

Tunnel diodes, Schottky diodes and application to detecting and mixing, Varactor diodes and application to multipliers, frequency converters, other parametric applications, PIN diodes, Step recovery diodes

第五讲: 两端电子器件 3 – Transit-Time 高频器件（6 学时）

Transferred electron devices, Impact Ionized Transit Time (IMPATT) devices, Other transit time devices including Resonant Tunneling Device (RTD)

第六讲: 三端电子器件 1 – 化合物半导体高频器件（6 学时）

Field Effect Transistor (FET), Metal-Semiconductor FET (MESFET) and noise model, Heterojunction Bipolar Transistor (HBT) and noise model, High Electron Mobility Transistor (HEMT) and noise model

第七讲: 三端电子器件 2 – 新型硅基高频器件（6 学时）

Silicon Laterally Diffused Metal Oxide Semiconductor (LDMOS), SiGe Bipolar CMOS (BiCMOS), RF CMOS including silicon on sapphire and silicon on insulator process

第八讲：近期微电子学研究最新进展（6 学时）

《数字信号处理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE152

课程名称:	数字信号处理	英文名称:	Digital Signal Processing
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Digital signal processing is concerned with the digital representation of signals and the use of digital computers or digital circuits to analyze, modify, and extract information from signals. Increasingly, DSP is considered to be a core subject in electrical and computer engineering curricula. This course provides an introduction to digital signal processing for undergraduate students. The course begins with a discussion of the representation and analysis of discrete-time signal systems, including discrete-time signals in the time domain, discrete-time signals in the frequency domain, discrete-time Fourier transform and fast Fourier transform, the z-transform and so on. Then we will progress to digital filter design（including FIR filters and IIR filters） and spectral analysis, which are the two major branches of DSP. We will practice some applications of the theory covered in this course. The work involved will be both interesting and demanding.

三、教学内容、教学方式和学时安排

《计算机安全 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS251
课程名称:	计算机安全 II	英文名称:	Computer Security II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces fundamental principles, approaches, techniques, problems, and challenges in modern computer security. It covers security topics in software, operating systems, networks, wireless s

ystems, web, and smartphones, as well as basic cryptography. Students are expected to read and discuss research papers, and to conduct and present research projects.

三、教学内容、教学方式和学时安排

- Week 1: Principles of computer security
- Week 2-3: Software security
- Week 4-5: Operating system security
- Week 6-7: Network security
- Week 8-9: Web security
- Week 10-11: Smartphone security
- Week 12-13: Cryptography
- Week 14: Economic aspects of security
- Week 15: Project presentations

《计算机辅助验证》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS242
课程名称:	计算机辅助验证	英文名称:	Computer-Aided Verification
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

How can a programmer verify that the software/hardware/protocol (s)he has designed works correctly as intended? Computer-aided verification is a sub-discipline of computer science aimed at developing tools and techniques to assist programmers meet this goal.

This course is an introduction to the theory and applications of formal methods, a field of computer science and engineering concerned with the rigorous mathematical specification, design, and verification of systems. At its core, formal methods is about proof: formulating specifications that form proof obligations, designing systems to meet those obligations, and verifying, via algorithmic proof search, that the systems indeed meet their specifications.

The course will cover topics such as model checking, Boolean satisfiability (SAT) solving and satisfiability modulo theories (SMT). These techniques have become essential tools for the design and analysis of hardware, software, and cyber-physical systems.

三、教学内容、教学方式和学时安排

课堂教学内容	教学进度和学时安排	教学方式
1.Introduction to CAV	第 1 周,2 学时	课堂教学
2. SAT Solving	第 1 周,2 学时 第 2 周,2 学时 总计 4 学时	课堂教学
3. Binary Decision Diagrams (BDDs)	第 2 周,2 学时	课堂教学
4. Satisfiability Modulo Theories (SMT)	第 3 周,4 学时 第 4 周,2 学时 总计 6 学时	课堂教学
5. Model Checking and Temporal Logic	第 4 周,2 学时 第 5 周,4 学时 总计 6 学时	课堂教学
6.Automata-theoretic model checking	第 6 周,3 学时	课堂教学
7. Proposal presentation	第 6 周,1 学时	学生报告
8. Partial Order Reduction	第 7 周,2 学时	课堂教学
9.Symbolic Model Checking with BDD	第 7 周,2 学时	课堂教学
10.Symbolic Model Checking with SAT/SMT	第 8 周,2 学时	课堂教学
11.Abstraction and Abstraction Refinement	第 8 周,2 学时	课堂教学

12.Software Verification by Predicate Abstraction	第 9 周,2 学时	课堂教学
13.Dataflow analysis	第 9 周,2 学时	课堂教学
14.Combining Model Checking and Data-Flow Analysis	第 10 周,2 学时	课堂教学
15.Abstract interpretation	第 10 周,2 学时	课堂教学
16.Symbolic Execution	第 11 周,2 学时	课堂教学
17.Static analysis: Concolic testing	第 11 周,2 学时	课堂教学
18.Test-case generation	第 12 周,2 学时	课堂教学
19.Project presentation	第 12 周,2 学时	学生报告和演示

《机器学习》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS282
课程名称:	机器学习	英文名称:	Machine Learning
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:	概率论与数理统计		

二、课程简介和教学目的

Machine learning techniques focus on the study and construct algorithms that can learn and make predictions on data. It has been used with great success in areas such as computer vision, search engines, speech recognition, robotics, recommendation systems, bioinformatics, social networks,and finance. This course provides an introduction to machine learning. Emphasis is placed on the statistical models and optimization algorithms. The course begins by introducing several examples of supervised and unsupervised learning. The main body of the course focuses on the design of statistical learning models and on the optimization algorithms that are used to train them.

三、教学内容、教学方式和学时安排

Introduction

Week1: Introduction to machine learning. Features, labels, cost functions. Review of calculus and algebra. Examples. Introduction to optimization methods.

Supervised Learning

Week 2-3: Linear regression. The stochastic gradient descent method. Training erro r and generalization error. Variants, regularization and applications.

Week 4: Logistic Regression. The stochastic gradient method for logistic regression and how it suggests the concept of generalized linear models.

Week 5: Multi-class logistic classification. Online Learning. Introduction to Neural Networks. Locally weighted linear regression.

Week 6: Support vector machines. Separable case. Properties of the gradient metho d.

Week 7: Introduction to convex optimization. Duality. Support Vector.

Week 8-9: Kernels. Optimization methods for training support vector machines, Va riants.

Week 10-11: Model selection. Feature selection. Boosting

Week 12: Generative Learning methods. Naive Bayes method. KNN.

Learning theory

Week 13: VC dimension. Bias vs variance

Unsupervised Learning

Week 14-15: Clustering. K-means. The EM Method. Mixture of Gaussian PCA and IPCA

Week 16: Deep Learning (Modern Neural Networks) Motivation, definition and trai ning

《计算机图形学 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS271
课程名称:	计算机图形学 II	英文名称:	Computer Graphics II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Research breakthroughs in 2D image analysis/synthesis, coupled with the growth of digital photography, have provided a practical and artistic medium for creating astonishing special effects in feature movies and computer games. This project/topics course gives a broad overview on modern computational approaches to generating digital images and videos.

This course is a convergence between computer vision, computer graphics, image processing, and photography. It will discuss in-depth a broad range of topics in digital photography and videos, including video capturing devices, novel camera models, non-traditional lighting and shading techniques, high dynamic range (HDR) vs. low dynamic range (LDR) images/videos, as well as many post-processing algorithms for generating context-rich images and videos.

三、教学内容、教学方式和学时安排

- Week 1: Introduction and motivating examples (movie special effects, robotics, medical imaging, etc)
- Week 2: Cameras Part I: Lens, Aperture, Focus.
- Week 3: Camera Part II: Shutter, Sensors, Flash.
- Week 4: Light Fields Modeling, Rendering, and Imaging.
- Week 5: Signal Processing and Frequency Domain Light Field Analysis.
- Week 6: Poisson Image Editing.

- Week 7: Graph-cut and Its Applications.
- Week 8: High Dynamic Range Imaging.
- Week 9: Bilateral Filters and Applications.
- Week 10: Image Matting.
- Week 11: Motion Blurs and Deblurs.
- Week 12: Next-Generation Cameras.
- Week 13: Course project presentations

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE242
课程名称:	网络信息论	英文名称:	Network Information Theory
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Introduction: Network information theory aims to establish the fundamental limits on information flow in networks and the optimal coding schemes that achieve these limits. We will introduce the classical results as well as the recent progress.

Objectives: Understand the concepts and techniques, and apply them in new systems.

三、教学内容、教学方式和学时安排

Course contents: Max-flow min-cut, typicality, packing lemma, covering lemma, convex envelope method, multiple access channels, broadcast channels, interference channels, relay channels.

Teaching: Class teaching.

Schedule: Introduction (three weeks), multiple access channels (two weeks), broadcast channels (three weeks), interference channels (three weeks), relay channels (two weeks).

《可再生能源系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE272
课程名称:	可再生能源系统	英文名称:	Renewable Energy Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程介绍可再生能源系统的基础知识。课程所介绍的内容覆盖从大型太阳能和风能发电系统到小型能量收集系统，此外亦介绍其他诸如潮汐和海洋等可再生能源发电技术。对于每一种可再生能源系统，均详细介绍其物理原理、系统的结构形式、功率调理电路、控制问题、以及相应的应用。此外每一种能源技术的优点和局限将在课程中得到充分的比较和探讨。课程所提供的实验和课程设计为同学们全面了解可再生能源技术提供很好的实践训练。

三、教学内容、教学方式和学时安排

1. 传统发电技术（6 课时）

2. 光伏发电系统（12 课时）

3. 风电系统（12 课时）

4. 其他可再生能源系统（2 课时）

5. 课程项目#1（4 课时）

6. 环境动能收集技术（12 课时）

7. 无线能量传输技术（10 课时）

8. 其他能量收集技术（2 课时）

课程项目#2（4 课时）

《人工智能 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS181
课程名称:	人工智能 I	英文名称:	Artificial Intelligence I
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

人工智能专题，包含：搜索、约束满足问题、博弈、符号逻辑、概率模型、强化学习、机器学习基础、自然语言处理基础等。

三、教学内容、教学方式和学时安排

简介	第 1 周
搜索	第 1 周
约束满足问题	第 2 周
博弈	第 3 周
符号逻辑	第 4-5 周
语义万维网	第 5 周
概率图模型	第 5-7 周
概率逻辑	第 7 周
概率时域模型	第 8 周
课程设计开题	第 9 周
增强学习	第 10-11 周
机器学习基础	第 12-13 周
自然语言处理基础	第 13-14 周
课程设计展示	第 15-16 周
人工智能哲学	第 16 周

《机电一体化》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS285
课程名称:	机电一体化	英文名称:	Mechatronics
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course is a complement to Soren’s Robotics course. While in the Robotics course there is a stronger emphasis on ROS and sensing for mobile wheeled robots (Distance sensors, Localization and Mapping), this Mechatronics course will complement the student’s set of skill to prepare them for the job market.

This course is open to all graduate students and 3rd and 4th year undergraduate students. It will focus on:
Controlling electric motors (brushed, brushless, servos) and motor drivers
Using sensors (force, temperature, light, distance, touch) and reading from a microcontroller
Programming embedded systems and robots with Arduino and Raspberry PI
Creating systems combining all these components with Machine Learning and Artificial Intelligence
Communicating with the user through Serial, Bluetooth, Infrared or Wifi

Homeworks will include small software exercises with Arduino written in C++.

Students will select a paper from a Robotics conference, read and understand it and then give a short presentation about it.
A significant part of the course will be a project. It will include a project proposal, where students will draft the required budget to create their proposed mechatronic system (below 150 yuan), and the design and implementation of it. Pure software projects are not acceptable. The students will also do a demonstration of their system and their final version should be presented as a Final Product for potential buyers (other professors can volunteer for evaluation). Experiments will be performed with this component and the findings are presented in a final report, a second presentation and a website. Depending on the class size, the project and all its related aspects might be done in small groups (up to three students).

三、教学内容、教学方式和学时安排

Week 1	Introduction Microcontrollers and Arduino hands-on	Propose HW1

Week 2	Arduino Control (PWM, DO, Servo) and LEDs Motors, servos, solenoids and drivers	HW1/Propose HW2
Week 3	Sensors (temperature, force, distance, potentiometer) Sampling sensor data (DI, Analog Input)	Paper selection
Week 4	Gyroscopes and Accelerometers Communication (Serial, Bluetooth, Wifi, SPI, I2C)	HW2/Propose HW3
Week 5	Finite State Machines/ Neural Networks (Embedded)	Paper presentation
Week 6	Genetic Algorithm/Simulated Annealing (Embedded) Reinforcement Learning and Inference	HW3
Week 7	Legged locomotion	
Week 8-16	Mechatronic Projects (project meetings twice per week during lecture hours. Close guidance to keep projects challenging and feasible, with lectures on demand) Projects with a clear real-world application are encouraged, in special solving university campus problems and with an incentive towards entrepreneurship.	
Week 17	Project presentation (Dragon Den style)	

《音频内容分析导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS190A
课程名称:	音频内容分析导论	英文名称:	An Introduction to Audio Content Analysis
学 分:	2	学 时:	32
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

Introduction to the software-based analysis of digital music signals. This course covers the basic approaches for musical content analysis and teaches students to approach this class of problems and think algorithmically. Topics include pitch tracking, beat tracking, audio feature extraction, and genre classification. The class focus is on the audio signal processing part of music information retrieval. After successful completion of the class, the students will be able to

summarize and explain baseline approaches to typical tasks in Music Information Retrieval,
describe and apply evaluation methods and metrics for audio content analysis systems, and
implement audio analysis systems in Matlab.

三、教学内容、教学方式和学时安排

Please find more indepth Module description on AudioContentAnalysis.org.

- Week 1, Modules 1.0, 2.0–2.7, 3.0–3.1:
  - introduction, fundamentals (signals, sampling, convolution, corrleation, Fourier transform), feature introduction
- Week 2, Modules 3.2–3.5, 4.0, 5.0–5.1
  - audio features and post-processing, pitch in music feature extraction
- Week 3, Modules 5.2–5.5, 6.0–6.2
  - pitch, key, tempo detection key detection
- Week 4, Modules 7.0–7.1, 8.0–8.3, 9

- audio alignment, genre classification, audio fingerprinting

《模拟与数字电路实验》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE115L
课程名称:	模拟与数字电路实验	英文名称:	Analog and Digital Circuits Lab
学 分:	1	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本实验课程包括：熟悉实验仪器及硬件平台、器件基本参数测定、放大电路设计、数字电路设计。
本课程目的在于使学生在学习《电路基础》、平台实验以及电子科技导论课程的基础上，补充和提高模拟与数字电路的综合应用能力，训练科学的思维和实验方法，培养学生的实验能力，并使学生掌握基本的实验方法和实验技能，为深入学习以后的专业课程打好基础。

三、教学内容、教学方式和学时安排

模拟电路与数字电路共计 8 个实验，每次预习实验至少 3 学时，每次实验时长为 3 学时；

实验开展方式为两名学生一组，根据选课班级时间自行组队；

每次实验分为：实验预习报告和实验报告，在实验开始前必须完成实验预习报告，否则不能开展实验，小组内每一名同学都需要提交实验预习报告，每小组提交一份实验报告。

《偏微分方程数值解》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI214
课程名称:	偏微分方程数值解	英文名称:	Numerical Methods for PDEs
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:	数值分析		

二、课程简介和教学目的

The goals of this course are to introduce the main concepts of numerical methods for partial differential equations, and to indicate how they can be used in other parts of mathematics and other fields such as engineering, physics, etc.

三、教学内容、教学方式和学时安排

1. Parabolic equations in one space variable (8 Lectures)

2. 2D parabolic equations (8 Lectures)

3. Hyperbolic equations in one space variable (8 Lectures)

4. Elliptic equations (8 Lectures)

5. Iterative methods (8 Lectures)

6. Advanced methods and research topics (8 Lectures)

7. Programing (16 Lectures)

《高级电能变换技术》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE273
课程名称:	高级电能变换技术	英文名称:	Advanced Power Conversion Techniques
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

Power electronics is the ″enabling infrastructure technology″ that promotes the conversion of electrical power from its raw form to the form needed by machines, motors, and electronic equipment. It is dedicated to improving electrical power processing and distribution that impact systems of all sizes - from battery-operated electronics, to vehicles, to regional and national electrical distribution systems. This course is to give a broad view of power electronics converters, including the PWM converters, the resonant converters, the quasi-resonant converters, the multi-resonant converters, and the soft-switching PWM converters. The students are expected to understand the operation mode, design process, and control methods of different converters.

三、教学内容、教学方式和学时安排

Chapter 1. Introduction
Chapter 2. PWM Converters
Chapter 3. Resonant Converters
Chapter 4. Quasi-Resonant Converters (Optional)
Chapter 5. Multi-Resonant Converters (Optional)
Chapter 6. Soft-Switching PWM Converters (Optional)
Chapter 7. GaN Devices and Application

《无线通信》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE241
课程名称:	无线通信	英文名称:	Fundamentals of Wireless Communications
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course covers the channel characteristics and modeling, communication concepts and techniques, and the application of these concepts in a system context.
After learning this course, the students should have a better understand on the concepts and techniques of communication systems, on the LTE standards, and on the key techniques of 5G systems.

三、教学内容、教学方式和学时安排

Course contents: wireless channels, diversity technique, multiple access and interference management in cellular systems, multiuser capacity, multiple-input multiple-output (MIMO), LTE standards, key techniques, challenges, and applications of 5G. **Teaching**: Class teaching.
Schedule: Wireless channels (one week), diversity technique (two weeks), cellular systems (two weeks), channel capacity (one week), multiuser diversity (one week), MIMO (three weeks), LTE standards (two weeks), 5G systems (three weeks), presentation (one week)

《传感技术及接口电路》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE225
课程名称:	传感技术及接口电路	英文名称:	Sensing Technologies and Interface Circuit
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程介绍各种类型的传感器，接口电路及其应用。涵盖了各种传感器架构的原理，包括用于机械量的传感器，如压力，应变，位移，接近和热，电场和磁场，光学，声学。还讨论了简单的传感器信号处理算法。此外，讲座还介绍了将传感器集成到系统中的方法。

目标：本课程分为两大类（1）理论上了解不同类型传感器和系统运行背后的各种物理现象，（2）设计具有适当接口电路作成为整个系统。
在本课程中讨论的各种类型的传感器是磁性，光学，生物，化学，电气和机械等。一般来说，学生将了解当前的传感器技术：电子，光子，微流体和新材料。课程重点是电子与传感器的集成，以提供智能传感器或具有多个集成设备的芯片系统。

学习目标：在本课程结束时，学生将能够：

1.为给定的应用选择合适的传感器。 2.设计基本电路构建模块。 3.模拟，合成和布局完整的传感器或传感器系统，MEMS 器件或微系统。

三、教学内容、教学方式和学时安排

Week	Topic
1	引言；电阻，电感与电容
2	运放电路；功能电路
3	滤波电路；电源电路
4	传感器基础
5	电阻式传感器与电路
6	电抗式传感器与电路
7	热电偶，霍尔传感器与电路
8	压电传感器与电路
9	光传感器与电路
10	谐振传感器与电路
11	其它传感器与电路
12	信号的处理
13	信号的调制解调
14	传感器系统

《计算理论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS244
课程名称:	计算理论	英文名称:	Theory of Computation
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

This course is intended as an upper-level undergraduate or introductory graduate coursein computer science theory. This course is an introduction to the foundation of computation, and aims at answering some of the most fundamental questions in computer science: What is an algorithm? What can and cannot be computed at all? What can and cannot be computed efficiently? The topics covered include set theory and countability, formal languages, finite automata and regular languages, pushdown automata and context-free languages, Turing machines, undecidability, P and NP, NP-completeness.
Warning: This is a rigorous mathematical course with emphasis on theorems and proofs, and is very different from most other CS courses.

三、教学内容、教学方式和学时安排

WEEK	DATES	MONDAY	WEDNESDAY	HW&PROJECTS
1		Course Introduction Sets, Relations, and Functions	Languages and Regular Expressions	
2		Languages and Regular Expressions	Countability and uncountability Deterministic Finite Automata	
3		Nondeterministic Finite Automata	DFA = NFA = regular expression	
4		Properties of Regular Languages	The Pumping Theorem for regular languages,	HW 1: Covers lectures 1-7
5		Context=free grammars & context-free languages	Context=free grammars & context-free languages	
6		Pushdown automata	Pushdown automata = Context-free languages	
7		Closure Properties of CFLs	The Pumping Theorem for CFLs	HW 2: Covers lectures 7-14
8		Q & A for midterm	Turing Machines	
9		Computing with Turing Machines	Computing with Turing Machines	

10		Extensions of TMs; the Church-Turing Thesis (Omit: Random Access TM)	Extensions of TMs; the Church-Turing Thesis (Omit: Random Access TM)	
11		Closure Properties of R. and R.E. Languages	Universal Turing Machines	HW 3: Covers lectures 16-21
12		The halting problem	Undecidable problems (Omit: Rice's theorem)	
13		Undecidable problems (Omit: Rice's theorem)	Tiling Problem	
14		P and NP·	P and NP·	
15		NP-completeness	NP-completeness	HW 4: Covers lectures 22-27
16		Symbolic automata Buchi automata		

《算法基础》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS140
课程名称:	算法基础	英文名称:	Algorithms
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

″The goal of this course is to give the students a good working know ledge of important algorithms in several domains and to give the stu dents an appreciation for, and an understanding of, algorithm design and analysis. Major topics to be covered in this course include ? D esign and analysis of algorithms: worst/average case analysis, proof s for correctness and performance of algorithms. ? Algorithmic strat egies (divide and conquer, greedy methods, dynamic programming, et c.). ? Algorithms for searching, forming and traversal of strings, t

rees and graphs. ? Categorization of computational problems: classes P and NP. ? NP completeness.″

三、教学内容、教学方式和学时安排

Week	Date	Topic	Readings
1		Overview and Syllabus Algorithm Analysis	Chapters 1 and 2
2		Optimality and Big Oh	Chapters 2 and 3
3		Induction & Recursion Quicksort and Master Theorem	Chapters 4.4, 4.5 Chapter 7, Chapter 9
4		Heapsort	Chapter 6
5		Sorting in Linear Time	Chapter 8.1 - 8.3
6		Binary Search Tree	Chapter 12
7		Red-Black Tree and Binary Space Partition	Chapter 13.1 - 13.3 RB-Tree demo, BSP demo
8		Greedy Algorithm Midterm exam	Chapter 16.1, 16.2 (except Greedy vs. Dynamic Programming section)
9		Dynamic Programming vs. Greedy Algorithm	3SUM problem, coin change problem
10		Graph & BFS Depth First Search	Chapter 22.1, 22.2 Chapter 22.3, 22.4, 22.5
11		Minimum Spanning Tree	Chapter 23
12		Shortest Path Algorithms	Chapter 24
13		String Matching KMP algorithm Approximate String Matching	Chapter 32.1, 32.3 Chapter 32.4
14		NP Problems I	Chapter 34
15		NP Problems II	Chapter 34
16		Image Segmentation Final guide	

《数字集成电路 I》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE113
课程名称:	数字集成电路 I	英文名称:	Digital Integrated Circuit Design
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course is an introduction to digital integrated circuits. The material will cover CMOS devices and manufacturing technology along with CMOS inverters and gates. Other topics include propagation delay, noise margins, power dissipation, and regenerative logic circuits. We will look at various design styles and architectures as well as the issues that designers must face, such as technology scaling and the impact of interconnect. Examples presented in class include arithmetic circuits, semiconductor memories, and other novel circuits.

三、教学内容、教学方式和学时安排

1. The course will start with a detailed description and analysis of the core digital design block, the inverter. Implementations in CMOS will be discussed.
2. Next, the design of more complex combinational gates such as NAND, NOR and EXORs will be discussed, looking at optimizing the speed, area, or power. The learned techniques will be applied on more evolved designs such as adders and multipliers.
3. The influence of interconnect parasitics on circuit performance and approaches to cope with them are treated in detail.
4. Substantial attention will then be devoted to sequential circuits, clocking approaches and memories.
5. The course will be concluded with an examination of design methodologies. CAD Tools for layout, extraction, and simulation will be used for assignments, labs and projects.

《数据结构》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS101W
课程名称:	数据结构	英文名称:	Data Structures
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

″This course introduces mathematical modeling of computational problems. It covers basic data structures and algorithms for solving these problems, and performance measurement and analysis techniques for these problems. Topics include: Algorithm design and analysis: performance measurement, asymptotic notation. Elementary data structures: linked lists, stacks, queues. Trees: binary search trees, balanced trees, B-trees, disjoint sets. Sorting: merge, heap, and quick sort. Graph algorithms: breadth-first search, depth-first search, topological sort, minimum spanning trees, single-source shortest paths. Hashing: hash functions and tables.″

三、教学内容、教学方式和学时安排

Introduction	Week 1
Algorithm performance measurement and asymptotic notation	Week 2
Elementary data structures	Week 3-4
Trees	Week 5-7
Sorting	Week 8-10
Graphs	Week 11-13
Hashing	Week 14
Advanced topics	Week 15

《激光原理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE125
课程名称:	激光原理	英文名称:	Principles of Lasers
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces fundamentals of Electromagnetic Optics & lasers; The lectures include 1. Electromagnetic optics; 2. Blackbody radiation theory; 3. Spontaneous emission; 4. Gain & Stimulated emission; 5. Line broadening 6. Gain saturation; 7. Nonradiative emission; 8. Energy levels and states; 9. Optical resonator; 10. Continuous-wave laser; 11. Laser oscillation & pulsation; The reference textbooks are: B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics" Wiley,1991; Orazio Svelto, "Principles of Lasers," Springer, 2010;

三、教学内容、教学方式和学时安排

L1-L2: Introduction on optics and lasers

L3-L10: Electromagnetic theory of light

L11-L15: Basic concepts of lasers

L16-L30: Laser medium

L31-L38: Laser resonator

L39-L50: Continuous-wave laser

L51-L60: Pulsed laser

L61-L64: Project and presentation (English)

Final Examination

《优化控制》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290E
课程名称:	优化控制	英文名称:	Optimal Control
学 分:	1	学 时:	16
授课对象:		授课语言:	
先修课程:			

二、课程简介和教学目的

This short course on “Optimal Control” provides an overview of basic theory, numerical methods and algorithms, as well as applications of optimal control. We cover the formulation of optimal control problems, Pontryagin’s maximum principle and the associated indirect optimal control methods, as well as modern direct numerical methods for optimal control such as multiple shooting and direct collocation. The students will also learn how to use the optimal control software ACADO Toolkit, which will be used for self-chosen projects. The grades for this course are based on a project report and presentation.

三、教学内容、教学方式和学时安排

The course “Optimal Control” consists of 16h of lectures and class exercises in total. Topics covered in the course are:

1. Introduction to and overview of application areas of optimal control
2. Mathematical formulation of optimal control problems
3. Pontryagin's maximum principle
4. Indirect numerical methods for solving optimal control problems
5. Direct methods for optimal control including multiple shooting and direction collocation methods.
6. Introduction to the optimal control software ADADO Toolkit.

All lectures are accompanied by pencil & paper as well as computer exercises and self-chosen projects.

《Advanced Computer Architecture》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS210G
课程名称:	Advanced Computer Architecture	英文名称:	Advanced Computer Architecture
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

In this graduate class, we will address advanced topics in the area of computer architecture. We presume that students who will take this class have a basic knowledge of computer architecture and/or operating systems. This course will be research intensive, aiming at deriving practical and achievable ground rules for computer architecture design. Each student is expected to do a research project including a written report and an in-class presentation on a topic to be arranged with the instructor. You will be expected to collaborate with other students toward the completion of the research project related to computer architecture.

三、教学内容、教学方式和学时安排

《控制原理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE160
课程名称:	控制原理	英文名称:	Introduction to Control
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The course “Introduction to Control” provides an overview of control systems. The first part of the course focuses on the basic intuition and model-free control learning. You will learn how to regulate basic single-input-single-output system with PID controllers. The second part of the course introduces all students to linear differential equations systems and modeling of basic electrical and mechanical control systems. The course covers both basic control theory including stability analysis of open-loop and closed-loop systems as well as state-space analysis method using the concepts of observability and controllability. Outdated frequency space analysis methods (such as Bode diagrams) will not be covered, but Fourier transforms will be introduced in order to understand the physics of noise and resonance and how to amplify or damp it. Moreover, all students will learn how to use Matlab to simulate and design control systems. Active participation in numerous smaller and bigger programming projects is required. The course is highly recommended for all students in the field of engineering, mathematics, physics, and computer science, who want to develop a basic understanding of control. The course is mandatory for everyone who wants to work in electrical or electronic engineering, circuit design, robotics, signal processing, network algorithms, and optimal control.

三、教学内容、教学方式和学时安排

The course “Introduction to Control” consists of 64h of lectures and class exercises in total. Topics covered in the course are:

1. Basic Intuition of Control
2. Single-Input-Single-Output Systems
3. Proportional Control (P Control)
4. Proportional-Integral-Differential Control (PID Control)
5. Tuning PID Controllers with Matlab (or Julia)
6. Linear Differential Equation Models
7. Modeling Basic Electrical and Mechanical System
8. Simulation of Linear Systems with Matlab (or Julia)
9. Steady States
10. Open-Loop Stability Analysis
11. Closed-Loop Stability Analysis
12. Fourier Transforms
13. Frequency Response Analysis and Resonance
14. Observers and Basic Noise Filters
15. Controllability and Observability
16. Kalman Filter (from a user perspective, not all math details)
17. Linear Quadratic Regulators (from a user perspective, not all math details)

All lectures are accompanied by pencil & paper as well as computer exercises.

《半导体器件基础》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE120
课程名称:	半导体器件基础	英文名称:	Fundamentals of Semiconductor Devices
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程的目标是让学生了解半导体物理和半导体器件的基本原理，为电子工程专业学生选修高级专业课程打下扎实的基础，本课程将会主要讲解半导体材料，以及 p-n 结，BJT,MOSFET 等器件的基本工作原理。本课程是一门“语言类课程”，学生学完本科程之后，如同学会一种“语言”，可以和器件等相关领域的同行进行深入交流，并且初步具备在微电子器件，光电子器件等领域进行研究的能力，也同时加强了对后续集成电路，集成系统类课程的理解。

三、教学内容、教学方式和学时安排

教学进度（周）	学时	内容	教学方式
1	1	背景与简介	课堂教学
1	3	半导体的晶体结构、晶列晶面指数、结合性质	课堂教学
2	4	量子力学简介	课堂教学
3	4	能带结构	课堂教学
4	4	统计力学，态密度和掺杂	课堂教学
5	2	载流子迁移	课堂教学
5	2	载流子扩散	课堂教学
6	4	连续型方程，载流子复合和产生机制	课堂教学
7	4	期中考试和复习	开卷（带一张 A4 纸）
8	2	PN 结静电场分布	课堂教学
8	2	PN 结电流	课堂教学
9	2	PN 结电容	课堂教学
9	2	肖特基结	课堂教学
10	2	BJT 简介	课堂教学

10	2	BJT 增益	课堂教学
11	2	BJT 设计	课堂教学
11	2	BJT 高频响应	课堂教学
12	4	MOS 电容和 MOSFET 简介	课堂教学
13	4	MOSFET 非理想效应和高频特性	课堂教学
14	4	其他半导体器件简介	课堂教学
15	4	课程报告	课程报告
16	4	复习与期末考试	开卷（带一张 A4 纸）

《嵌入式系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE114
课程名称:	嵌入式系统	英文名称:	Introduction to Embedded Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces students to the design and analysis of embedded systems which interact with physical processes. A major emphasis will be on building high confidence systems with real-time and concurrent behaviors. Applications of such systems include medical devices and systems, consumer electronics, toys and games, assisted living, traffic control and safety, automotive systems, process control, energy management and conservation, environmental control, aircraft control systems, communications systems, instrumentation, critical infrastructure control (electric power, water resources, and communications systems for example), robotics and distributed robotics (telepresence, telemedicine), defense systems, manufacturing, and smart structures. A major theme of this course is on the interplay of practical design with models of systems, including both software components and physical dynamics. The course project is run in parallel as an important component of the course.

三、教学内容、教学方式和学时安排

The contents are listed as follows. Some contents might take up more than one lectur es.

1 Cyber-Physical Systems and Introduction to the Course

2 Sensors and Actuators

3 Model-Based Design, Continuous Dynamics

4 Memory Architectures

5 Input and Output

6 Modeling Modal Behavior, Discrete Dynamics

7 Extended and Timed Automata

8 Composition of State Machines

9 Hierarchical State Machines

10 Specification; Temporal Logic

11 Comparing State Machines

12 Reachability Analysis

13 Using Temporal Logic in CPS Autograders

14 Multitasking

15 Operating Systems, Microkernels, and Scheduling

16 Scheduling Anomalies

17 Execution Time Analysis

18 Synchronous/Reactive and Dataflow Models

19 Security for Embedded Systems

20 Networked Embedded Systems

《数值分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI211H
课程名称:	数值分析	英文名称:	Numerical Analysis
学 分:	3	学 时:	48
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The course “Numerical Analysis” provides an overview of basic numerical methods and algorithms covering the representation of numbers and arithmetic operations in a computer, error analysis for simple computer arithmetics, interpolation and regression, orthogonal polynomials and quadrature formulas, linear and nonlinear equation systems including direct and iterative methods as well as basic optimization algorithms. The course is highly recommended for all students in the field of engineering, mathematics, physics, and computer science, who want to work with computer algorithms and engineering software. A deep background in numerical analysis is the basis for many research directions including simulation and computer analysis of dynamic processes, optimization and control, identification and estimation, computer vision, signal processing, as well as network algorithms and communication.

三、教学内容、教学方式和学时安排

The course “Numerical Analysis” consists of 48h of lectures and class exercises in total. Topics covered in the course are:

1. Computer representation of numbers and rounding errors
2. Conditioning of arithmetic operations
3. Stability of numerical algorithms
4. Polynomial Interpolation
5. Extrapolation Methods and Limits
6. Splines
7. Trigonometric Approximation and Fast Fourier Transforms (FFT)
8. Orthogonal Polynomials
9. Numerical Integration and Quadrature Formulas
10. Linear Equation Systems and Error Analysis
11. Linear Elimination Methods including Gauss-Elimination
12. Structured Linear Equation Systems and Sparsity
13. Least Squares Optimization

14. Nonlinear Equations Systems and Newton's Method
15. Convergence Analysis of Newton's Method
16. Gauss-Newton Methods
17. Low-Rank Matrix Updates
18. Sequential Quadratic Programming

All lectures are accompanied by pencil & paper as well as computer exercises. A “cr ash-course” on the computer language JULIA will be provided.

《图论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI221
课程名称:	图论	英文名称:	Graph Theory
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

图论是一个应用广泛的数学分支．它对于计算机科学、运筹学、信息论、概率论、代数学、物理学、化学以及社会科学都有广泛的应用。它既对抽象问题的解决提供直观的解释和工具，又对许多实际的问题提供解决的方法。

教学目的：

- 图论基本知识
- 图论在工程学中的应用
- 图论算法的理解与掌握与 C++实现

三、教学内容、教学方式和学时安排

WEEK	DATES	MONDAY	WEDNESDAY	HW&PROJECTS
1		导论	图和子图	
2		图和子图	树	
3		树	联通性	
4		联通性	联通性	HW 1: Covers lectures 1-7
5		欧拉回路和哈密尔顿圈	欧拉回路和哈密尔顿圈	Coding Assignment 1: Covers lecture 1-10
6		图匹配	图匹配	

7		边着色	边着色	HW 2: Covers lectures 7-15
8		独立集与团	独立集与团	
9		独立集与团	顶点着色	Coding Assignment 2: Covers lecture 16-18
10		顶点着色	顶点着色	HW 3: Covers lectures 16-21
11		平面图	平面图	
12		平面图	有向图	
13		有向图	有向图	Coding assignment 3: Covers lecture 19-22
14		网络·	网络·	
15		圈空间和键空间	圈空间和键空间	HW 4: Covers lectures 22-27
16		图和矩阵	图和矩阵	

《数字信号处理的 VLSI 实现》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE252
课程名称:	数字信号处理的 VLSI 实现	英文名称:	VLSI Implementation of DSP
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Digital signal processing (DSP) is used in numerous applications such as wireless communication, video and audio signal processing, radar signal processing, et. al. The Field of DSP has always been driven by the advances in DSP applications and in scaled very-large-scale-integrated (VLSI) technologies. At any given time, DSP applications impose several challenges on the implementation of the DSP systems. This course aims to cover the methodologies needed for the design and implementation of custom or semi-custom VLSI circuits for these DSP systems.

三、教学内容、教学方式和学时安排

1. Introduction

2. Iteration bound

3. Pipelining and parallel processing

4. Retiming

5. Unfolding

6. Folding

7. Algorithmic strength seduction

8. Numerical strength reduction

9. Bit-level arithmetic architectures

10. Scaling and roundoff noise

《线性系统 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE261H
课程名称:	线性系统 II	英文名称:	Linear Systems II
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course introduces fundamentals in linear system theory. It includes mathematical descriptions, analysis, and design (i.e., control) of linear systems. The course is appropriate for graduate students who are interested in control systems, dynamical systems, signal processing, circuit analysis, etc.

三、教学内容、教学方式和学时安排

Mathematical description of linear systems

-Input-output description

-State-space description

Analysis of linear systems

-State-space solutions

-Equivalent state-space equations

-Realizations and canonical forms

-Input-output stability

-Internal stability and Lyapunov theorem

-Controllability and observability

-Kalman decomposition

Design of Linear systems (linear Control)

-State and output feedback

-Pole placement

-Regulation and tracking

-State estimator

-H2, H infinity control

-Kalman Filter

《信道编码理论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE243H
课程名称:	信道编码理论	英文名称:	Channel Coding Theory
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

Coding Theory is a graduate-level class that introduces the theory and practice of error-control coding. Error control techniques for digital data are widely used in applications in our everyday life. They are used in digital transmission systems to eliminate transmission errors and in magnetic, optical, and semiconductor storage devices as hard disks, DVDs, or flash memory to cancel read and write errors. Topics covered in class include algebraic codes (cyclic codes, BCH codes, Reed-Solomon codes), convolutional codes, and modern graph-based codes (Turbo odes and LDPC codes). Most codes will be discussed in the context of channel coding. The objectives of the course are to understand the theoretical framework upon which error-control codes are built
to implement some of the error-control codes discussed in class

三、教学内容、教学方式和学时安排

Content	Hours
Introduction	4
Linear algebra	4
Linear block codes	8
Convolutional codes	8
Advanced topics Midterm	4
Turbo codes	6
LDPC codes	8
Polar codes and other advanced topics Final	6

《射频电子学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE235
课程名称:	射频电子学	英文名称:	Radio-frequency Electronics
学 分:	3	学 时:	48

授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

A graduate level to the physics that underlies the operation of microwave/RF electronics including the physical principles and design considerations of microwave solid-state devices: Schottky barrier mixer diodes, IMPATT diodes, transferred electron devices, tunnel diodes, microwave transistors, and relevant fundamentals of microwave/RF signal processing.

三、教学内容、教学方式和学时安排

Lecture 1: Review of relevant material on the physics of semiconductors

Lattices, Brillouin zone and symmetry, energy bands in bulk, E-k relations, Block functions, Si and GaAs, quantum confined structures, densities of states and statistics, carrier density, p-n junction, Bipolar Junction Transistor (BJT), Metal-Oxide-Semiconductor Transistor (MOSFET)

Lecture 2: Review of the origins of noise in semiconductors, noise figure characterization

Thermal noise, shot noise, flicker noise, diffusion noise, impact ionization noise, noise figure

Lecture 3: Review of microwave engineering

Maxwell equations, transmission line theory, waveguide, microwave network analysis

Lecture 4: Two terminal microwave devices I – Microwave/RF signal processing, generation, amplification

power detection, frequency conversion (signal mixing), amplitude control (RF attenuator), Phase control (phase shifter), RF switching, fundamental oscillator, harmonic generator, frequency upconverter, Parametrically induced negative resistance, Internally generated negative resistance

Lecture 5: Two terminal microwave devices I – Junction devices

Tunnel diodes, Schottky diodes and application to detecting and mixing, Varactor diodes and application to multipliers, frequency converters, other parametric applications, PIN diodes, Step recovery diodes

Lecture 6: Two terminal microwave devices II – Transit time devices

Transferred electron devices, Impact Ionized Transit Time (IMPATT) devices, Other transit time devices including Resonant Tunneling Device (RTD)

Lecture 7: Three terminal microwave devices I – Compound Semiconductor devices

Field Effect Transistor (FET), Metal-Semiconductor FET (MESFET) and noise model, Heterojunction Bipolar Transistor (HBT) and noise model, High Electron Mobility Transistor (HEMT) and noise model

Lecture 8: Three terminal microwave devices II – Advanced RF Silicon Technology

Silicon Laterally Diffused Metal Oxide Semiconductor (LDMOS), SiGe Bipolar CMOS (BiCMOS), RF CMOS including silicon on sapphire and silicon on insulator process

Lecture 9: Recent advances in MSD technology and applications

《电力电子》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE270H
课程名称:	电力电子	英文名称:	Power Electronics
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

An introduction to switched-mode dc-dc converters. The first part of the course treats basic circuit operation, including steady-state converter modeling and analysis, switch realization, discontinuous conduction mode, and transformer-isolated converters. Next, converter control systems are covered, including ac modeling of converters using averaged methods, small-signal transfer functions, and classical feedback loop design. Finally, magnetics design for switched-mode applications is discussed, including: basic magnetics, the skin and proximity effects, inductor design, transformer design.

三、教学内容、教学方式和学时安排

In this section, please list topics and schedule in detail.

Week 1 Introduction

Week 2 Principle of steady state converter analysis

Week 3-4 Steady state equivalent circuit modeling, losses, and efficiency

Week 5 Switch realization

Week 6 Discontinuous conduction mode

Week 7-8 Converter circuits

Week 9-10 ac equivalent circuit modeling

Week 11 Converter transfer functions

Week 12 controller design

Week 13 basic magnetic theory

Week 14 Inductor design

Week 15 Transformer design

Week 16-18 Final project

《信息科学技术导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100
课程名称:	信息科学技术导论	英文名称:	Introduction to Information Science and Technology
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course consists of four components.

- Programming. This section is for students with good programming skills. We will introduce advanced topics in developing fast, memory safe, thread safe programs using Rust. Topics include:

- Ownership, borrowing, and lifetime
- Generics and traits
- Closures
- Concurrent programming
- Functional programming

- Robotics. This part of the course gives a short overview of some important topics within this area, concentrating on algorithms and software. First robotics in general will be introduced, as well as the problem of how to write software for robotics. Then special lectures on specific topics will be presented: Mapping, Control, Optimization, Computer Vision, Artificial Intelligence (AI) and Machine Learning. The four-week robotics project starts with an introduction to and a tutorial on the Robot Operating System and the robot simulation software. Then the actual project topic is introduced. The implementation phase of the project is two weeks long, followed by final experiments with real robots.
- Signal and Systems. Provide an overview of the following areas:

- Signal Processing gives an overview of various signal processing techniques playing important roles in our everyday life.

- Communication touches on hot topics in several generations of wireless communications,
including 2G, 3G, and 4G, and covers the fundamentals behind these everevolving technologies.

- Information teaches the basic theory behind information and helps the students understand the problem, such as how we can reliably communicate through a non-reliable link.

- Networking helps students understand the structure and rationale of our current networking, which is the “core” of our current internet life.

- Control introduces the rich filed of control theory, which builds up the foundation for our modern automation.

- Electronics. Provide an entry level overview of the following areas: 1) Circuits Theory; 2) Devices and Sensors; 3) Analog Circuits; 4) Radio Frequency Circuits; 5) Digital Circuits; 6) Electronic Design Automation; 7) Power Electronics; 8) Power Systems and Renewable Energies.

There are labs based on projects and the homework is challenging.

三、教学内容、教学方式和学时安排

Week	Topic	Instructors
1-4	Electronics	Xufeng Kou
5-8	Programming	Hao Chen
9-12	Signal and Systems	Yi Ma
13-16	Robotics	Sren Schwertfeger

《操作系统 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS230
课程名称:	操作系统 II	英文名称:	Operating Systems II
学 分:	3	学 时:	48
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The purpose of this course is to teach the design of operating systems. Topics include multiple-program systems (processes, interprocess communication, and synchronization), memory allocation (segmentation, paging), resource allocation and scheduling, file systems, basic networking (packet switching, file control, reliability), security, and privacy.

三、教学内容、教学方式和学时安排

Lectures, discussions, labs, projects, and presentations.

《控制原理课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE160P
课程名称:	控制原理课程设计	英文名称:	Introduction to Control Project
学 分:	2	学 时:	96
授课对象:		授课语言:	英语

先修课程:	

二、课程简介和教学目的

The project EE160P is provided parallel to the course EE160, “Introduction to Control”. During the first lectures and project meetings every students is required to choose at least one application for a control system of her/his choice. The project topics need to be discussed during one-on-one sessions with the prof. Boris Houska or one of the TAs helping with the course. All major control theory and control algorithms that are taught during the EE160 course should also be tested, implemented, and understood by using Matlab or Julia as part of EE160P. During the semester the students will receive guidance on how to implement PID controllers, how to analyze steady-states, how to analyze stability, how to design observers and filters, and how to design advanced feedback controllers for the control system application of their choice. Towards the middle as well as towards the end of the semester the project results will be presented in smaller groups.

三、教学内容、教学方式和学时安排

The project EE160P accompanying the EE160 course “Introduction to Control” consists of 96h in total, not all spend in class. Topics covered are:

1. Introduction to Matlab (you may use Python or Julia if you prefer)
2. Modeling a selected (the students can choose) electrical , mechanical , or other cyber-physical system in depth and understanding its behavior
3. Simulation of the selected system in open-loop mode using MATLAB
4. Physical interpretation of simulation results
5. Implementation, tuning, and simulation of PID Control
6. Frequency Response and Resonance Analysis using MATLAB
7. Advanced Control Design (depending on the chosen project topic)

During the project the students will meet regularly in smaller groups as well as in one-on-one meetings with prof. Boris Houska or one of his TAs.

《算法博弈导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS243H

课程名称:	算法博弈导论	英文名称:	Introduction to Algorithmic Game Theory
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Over the past fifteen years, research in theoretical computer science, artificial intelligence, and microeconomics has joined forces to tackle problems involving incentives and computation. This research field, commonly named Algorithmic Game Theory, is becoming increasingly more relevant due to the prominence of the Internet as the computing platform. The research in algorithmic game theory is rooted in and has applications for a number of different academic disciplines such as computer science, math and economics. This course will introduce the foundation of algorithmic game theory and discusses its broad applications such as auctions, president elections, matching, crowdsourcing and peer predication.

三、教学内容、教学方式和学时安排

I. Game Theory Introduction
   a. Game Play: Nash equilibrium, dominant strategies, mixed strategies etc.
   b. Game Design: auctions, president election, crowdsourcing etc.

II. Auctions
   a. Second Price Auction (eBay auctions, Shanghai car plate auctions)
   b. Internet Advertising (Google, Baidu)
   c. Combinatorial Auction (spectrum auction)

III. Social Choice
   a. President Election (winner determination)
   b. Ranking (preference aggregation)

IV. Matching Markets
   a. Student-School Matching (college entrance examination/高考)
   b. Kidney Exchange (器官捐献)

V. Human Computation
   a. Crowdsourcing (image labeling)
   b. Peer Prediction (who is going to win the next world cup)

VI. Exchange Markets
   a. Double Auction (stock exchanges)
   b. Online Auction

c. The Sharing Economy Markets (car-sharing, house-sharing/Airbnb)

《基于 FPGA 的硬件系统设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE116
课程名称:	基于 FPGA 的硬件系统设计	英文名称:	FPGA-based Hardware System Design
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

In today's world, digital systems are everywhere - homes, offices, cars, factories and hospitals. Their huge numbers and new complexity call for new design approaches that emphasize high-level tools and hardware/software tradeoffs, rather than low-level assembly-language programming and gate-level logic design.

The goal of this module is to enable students to understand and practice the principles of designing complex digital systems. After completing this module, students will be able to translate system specifications into executable computation models using a high level specification language such as C program and map these executable specifications into a register-transfer level hardware description language (HDL) that will then be implemented on an FPGA.

In this course, the necessary skills are learned to perform the digital hardware part of a system design, and students will also design an AES encoder or decoder to be implemented on FPGA.

三、教学内容、教学方式和学时安排

The course includes several parts, such as lectures, tutorials, labs and course projects.

Lectures

Part 1: Digital System Platforms

This part helps students to understand what digital system platforms are and how the y are built. Topics include semiconductor fabrication, circuit design and platform co mponents like processors, ASIC and FPGAs, as well as the overall design methodolo gy to implement high level algorithms to platforms (4 weeks)

Part 2: Design Specification and Partition

This part focuses on the design specification using high level languages, software an d hardware partition and VHDL hardware description language. (4 weeks)

Part 3: Digital Hardware Design Trajectory

This part focuses on the design methodologies and tools for the digital hardware part of the system. Topics include behavioral synthesis which translates the high level har dware description from algorithms to the register transfer level design, logic synthesi s which translates the register transfer level description into the gate level descriptio n, and physical synthesis which translates gate level description into FPGA bitstream s. (6 weeks)

Part 4: Design Examples

This part uses two design examples to wrap up all the concepts in this module. The first design example studies the complete design flow and implementation of an application from its high level language specification into hardware design on FPG A. The second design example will be an invited talk by a manager from a recognize d company in FPGA-based system design related industry. He will introduce the desi gn methodologies and tools that they have practically used in industry. (2 weeks)

Labs and Course Project

Students are required to implement a digital system by studying the state-of-the-art E lectronic Design Automation (EDA) tools and FPGA development boards through a series of labs. These labs include VHDL hardware description language, EDA tools a nd FPGA development boards from Xilinx. After the labs, students are required to us e the learned tools and methodologies to work on a course design project, such as an AES encoder or decoder.

《计算机动画与物理仿真》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS275H
课程名称:	计算机动画与物理仿真	英文名称:	Computer Animation and Physical Simulation
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will introduce techniques to create computer-generated animations, from the initial non-physically-based and artistic to purely automatic and physically-based animations, and from 2D to 3D. In 2D animations, the course will mainly introduce animations based on key-frames, morphing, and triangle mesh deformation. However, the focus of this course is on 3D animations, where rigid body, soft body and fluid dynamics for creating realistic computer animations will be covered. Some special topics such as character animation, motion capture, robotics simulation etc. will also be introduced. After taking this course, the students will be able to master technologies to create customized computer animations and simulations, and do all things from scratch. The course assignments and project will be tightly related on how to implement and design some of these animations.

三、教学内容、教学方式和学时安排

The desired course schedule is as follows:

Lecture 1: Introduction to the course

Lecture 2: Computer Graphics for Animation I

Lecture 3: Computer Graphics for Animation II

Lecture 4: 2D Computer Animation - Key frames and morph-based

Lecture 5: 2D Computer Animation - Mesh deformation

Lecture 6: Particle System

Lecture 7: 3D Mesh Deformation

Lecture 8: Motion Capture

Lecture 9: Rigid Body Dynamics - Unconstrained

Lecture 10: Rigid Body Dynamics – Constrained

Lecture 11: Inverse Kinematics and Character Animation

Lecture 11: Collision Detection

Lecture 12: Soft Body Dynamics I - Mass-Spring System

Lecture 13: Soft Body Dynamics II – More Sophisticated Models

Lecture 14: Cloth and Hair Animation

Lecture 15: Fluid Dynamics

Lecture 16: Grid-based Fluid Simulation

Lecture 17: Grid-based Fluid Rendering

Lecture 18: Particle-based Fluid Simulation

Lecture 19: Particle-based Fluid Rendering

Lecture 20: Mesoscopic Models

Lecture 21: Animation of Smoke and Fire

Lecture 22: Animation of Water

Lecture 23: Coupling Fluids and Solids

Lecture 24: Other Topics in Physically-based Animation

《并行计算》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS121
课程名称:	并行计算	英文名称:	Parallel Computing
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course provides an introduction to parallel computing. It covers topics including motivations for parallelism, parallel architectures including distributed, shared memory and massively parallel systems, parallel performance analysis, partitioning and load balancing methods, loop parallelization and dependency analysis, distributed memory programming using MPI, shared memory programming using OpenMP, GPU programming using CUDA, optimization techniques for GPUs, and a number of parallel algorithms for graphs, matrices and other types of large datasets.

三、教学内容、教学方式和学时安排

Introduction and background for parallel computing. Distributed memory computations. Network architectures. Shared memory architectures. Synchronization issues. Performance analysis. MPI and distributed memory programming. Design of parallel algorithms. Shared memory programming using OpenMP. Optimizing loops. Load balancing. Introduction to GPU architecture. Programming GPUs using CUDA. GPU algorithms. Algorithms for sorting, dense and sparse matrices, prefix sums, pointer jumping, parallel graph algorithms, and other problems.

《随机过程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI241H
课程名称:	随机过程	英文名称:	Stochastic Processes
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程介绍随机过程的理论及其应用，主要内容包括概率论回顾，鞅，泊松过程，更新过程，马尔科夫链，排队过程，高斯过程以及平稳过程。教学目的是让学生系统的掌握分析随机模型以及设计随机算法的常用方法，并能够熟练运用这些方法去解决通信，网络，信号处理，机器学习等领域的相关实际问题。

三、教学内容、教学方式和学时安排

每周三个学时，共 16 周，教学方式以全英文授课为主。 具体的每周教学安排如下：

1. 概率论回顾以及概率论不等式
2. 条件概率以及鞅
3. 泊松过程
4. 更新过程
5. 离散时间马尔科夫链
6. 连续时间马尔科夫链
7. 排队过程
8. 高斯过程以及平稳过程

《密码学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS252H
课程名称:	密码学	英文名称:	Cryptography
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程是现代密码学的入门课程。 密码学的主要研究对象是保护数字信息、交易以及分布式计算的各种技术。密码学能提供主要理论基础和实用解决方案以抵御敏感信息、数据传输过程中非授权个体的侵害，其核心目标就是要保证所传输信息的机密性以及完整性。本课程将探讨对称和非对称加密技术，具体包括分组密码、对称加密方案、哈希函数、消息认证、认证加密方案、非对称加密方案、数字签名、公钥基础设施、密钥分发；本课程还将探讨上述密码技术的应用以及若干新型密码协议的构造，例如密钥共享、不经意传输、私有信息检索、安全计算以及零知识证明等。本课程将培养学习者以可证明安全的方法对各类信息安全问题作严格数学表述、求解与证明的能力。

三、教学内容、教学方式和学时安排

周次	教学内容	教学形式

1	Historical Ciphers and Their Cryptanalysis, Principles of Modern Cryptography Private-Key Encryption, Perfect Secrecy, One-Time Pad, Limitations of Perfect Secrecy, Shannon's Theorem	课堂教学，课后作业
2	Computational Security, IND-EAV Security, Semantic Security* PRG, Stream Ciphers, PRG-based Encryption, INDm-EAV Security, CPA Security	课堂教学，课后作业
3	PRF, PRP, Block Ciphers, PRF-based Encryption Modes of Operations, CCA Security	课堂教学，课后作业
4	Message Integrity, MAC, EUF-CMA Security, PRF-based MAC CBC-MAC	课堂教学，课后作业
5	Authenticated Encryption, CCA-Security Information-Theoretic MAC*, Homomorphic MAC*	课堂教学，课后作业
6	Practical Constructions of Stream Ciphers, SPN, Feistel Networks DES, AES	课堂教学，课后作业
7	CRHFs and Their Security, Birthday Attacks MD Transform, Hash-and-MAC, HMAC	课堂教学，课后作业
8	Basic Number Theory, Basic Group Theory, Elliptic Curves Cryptographic Hardness Assumptions	课堂教学，课后作业
9	Limitations of Private-Key Cryptography, Key Management, Public Revolution, Diffie-Hellman Key Exchange Public-Key Encryption	课堂教学，课后作业
10	Hybrid Encryption, ElGamal RSA	课堂教学，课后作业
11	Digital Signatures, EUF-CMA Security, Hash-and-Sign Paradigm RSA Signatures, Identification-based Signatures, DSA, ECDSA	课堂教学，课后作业
12	Secret Sharing Private Information Retrieval	课堂教学，课后作业
13	Oblivious Transfer (OT), Multi-Party Computation (MPC) Zero-Knowledge Proofs	课堂教学，课后作业
14	Final Exam	

《天线理论和设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE234
课程名称:	天线理论和设计	英文名称:	Antenna Theory and Design
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

内容包括：辐射，天线基本参数，辐射积分和辅助势函数，天线基本定理，线形天线，环形天线，天线阵列，天线合成技术，行波天线，面天线，微带天线，天线匹配，天线测量等。
使学生全面深入了解和掌握天线理论的基本概念以及分析和设计方法，学习使用相关的天线设计仿真软件，为分析和设计多种不同应用领域的天线打下基础，例如雷达，通信，探测，成像等。

三、教学内容、教学方式和学时安排

《信息科学技术导论 A》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100A
课程名称:	信息科学技术导论 A	英文名称:	Introduction to Information Science and Technology A
学 分:	6	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course consists of four components.

Programming. Introduce basic components of computer systems, including hardware, operating
systems, and application programs. Learn programming using Python on the Linux environment.
Study how to solve real world problems using fundamental data structures and algorithms.
Robotics. This part of the course gives a short overview of some important topics within this
area, concentrating on algorithms and software. First robotics in general will be introduced, as
well as the problem of how to write software for robotics. Then special lectures on specific topics
will be presented: Mapping, Control, Optimization, Computer Vision, Artificial Intelligence (AI)
and Machine Learning. The four week robotics project starts with an introduction to and a tutorial
on the Robot Operating System and the robot simulation software. Then the actual project topic is
introduced. The implementation phase of the project is two weeks long, followed by final
experiments with real robots.
Signal and Systems. Provide an overview of the following areas:
- Signal Processing gives an overview of various signal processing techniques playing
important roles in our everyday life.
- Communication touches on hot topics in several generations of wireless communications,
including 2G, 3G, and 4G, and covers the fundamentals behind these everevolving technologies.
- Information teaches the basic theory behind information and helps the students understand
Course Code SI100A
Course Title Introduction to Information Science and Technology A
Credit 6
Teaching Hours
64 Lecture+96
Lab&Practice
Major Open to all majors.
Prerequisite(s) None.
the problem, such as how we can reliably communicate through a non-reliable link.
- Networking helps students understand the structure and rationale of our current
networking, which is the “core” of our current internet life.

- Control introduces the rich filed of control theory, which builds up the foundation for our
modern automation.
Electronics. Provide an entry level overview of the following areas: 1) Circuits Theory; 2)
Devices and Sensors; 3) Analog Circuits; 4) Radio Frequency Circuits; 5) Digital Circuits; 6)
Electronic Design Automation; 7) Power Electronics; 8) Power Systems and Renewable Energies.
There are labs based on projects and the homework is challenging.

三、教学内容、教学方式和学时安排

Week Topic Instructors

1-4 Programming Hao Chen

5-8 Electronics Haoyu Wang

9-12 Robotics Soren Schwertfeger

13-16 Signal and Systems Xiliang Luo

《电磁学课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE130P
课程名称:	电磁学课程设计	英文名称:	Electromagnetics Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程是电磁学理论课学习的补充和延伸，主要培养学生利用所学理论知识动手实践的能力，涉及实际应用原理学习、电磁仿真软件学习、天线设计制作及测量、实验系统搭建、实验数据处理等多方面的训练。
课程设计的具体题目有两个：第一是微波雷达成像，第二是相控阵天线。
微波雷达成像包括雷达成像原理的学习，雷达天线具体参数及要求的学习，了解物体大小形状及距离对成像效果的影响，根据物体的回波信号初步区分物体

形状，设计频率选择表面使雷达具备一定的抗干扰性，制作并测试频率选择表面，在室外应用雷达识别人及车辆等。
相控阵天线包括微带天线的原理学习，学习天线匹配，用软件仿真并调节天线参数，对比不同参数对天线性能的影响，设计天线阵列，调节相位及幅度参数合成天线方向图，制作并测试相控阵天线。

三、教学内容、教学方式和学时安排

教学内容	教学进度和学时安排	教学方式
雷达成像及微带天线的理论介绍	4 学时	课堂教学、课后讨论
课堂实验演示	2 学时	课堂教学
实验操作	26 学时	实验课

《电路基础课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE111P
课程名称:	电路基础课程设计	英文名称:	Electric Circuits Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

《电路基础课程设计》通过一系列的课程实验与设计，使学生巩固和扩展所学的理论知识；熟悉基本的实验设备和电路元件的使用方法；了解简单电路模块的搭建和测试方法；锻炼分析和解决实际问题的能力；学习对实验结果进行分析与处理的方法；养成良好的实验习惯和严谨的科学作风。

三、教学内容、教学方式和学时安排

实验一 常用电子仪器仪表以及电路仿真软件介绍

实验二 三端变阻器

实验三 戴维南等效电路

实验四 含有非独立电源的电路的研究

实验五 RC 电路频率特性的研究

实验六 RLC 串联电路的幅频特性和谐振现象

实验七 电路过渡过程的研究

实验八 用模拟计算机求电路方程的解

九 开放性课程设计

《数字集成电路 I 课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE113P
课程名称:	数字集成电路 I 课程设计	英文名称:	Digital Integrated Circuit Design Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

该课程为数字集成电路 I 的辅助课程设计，主要包含了两个部分：第一部分是利用 Multisim 软件熟悉数字逻辑电路的设计，第二部分是利用 Cadence 软件初步了解实际数字集成电路的设计、仿真与优化。第一部分包含了 4 个独立的实验以及一个期中课程设计（optional），第二部分主要是学习掌握 Cadence 软件，并利用它完成最后的课程设计“800MHz 4-bit absolute-value detector”。

三、教学内容、教学方式和学时安排

实验一: Multisim 软件与逻辑门

Get familiar with Multisim software; use Multisim to simulate a 3-input AND gate with input waveforms that cycle through binary numbers 0 through 9; simple logic gate circuit design project

实验二: 逻辑化简与组合逻辑电路分析

Basic laws and rules of Boolean algebra; example & exercise on logic simplification; design a logic to show the digits 0-9 by a 7-segment display; basic combinational logic circuits; example & exercise 2; combinational logic circuit debug and analysis.

实验三：组合逻辑电路设计

Adder logic; four-bit parallel adder circuit; design a voting system for 9 voters by using full adders; design a control logic circuit for a traffic signal.

实验四：时序逻辑电路设计

Latches & Flip-Flops; design a voting system which allows voters to vote one by one; design a multi-controlled logic circuit for a traffic control system.

期中课程设计: Self-design Project by Multisim (Optional)

实验五: Introduction of Cadence

实验六: Hierarchical Schematic and Simulation

实验七: Virtuoso Layout Editing (DRC, LVS)

实验八: Schematic-driven layout

期末课程设计: Optimal 800MHz 4-Bit “Absolute-value Detector”

The goal of this project is to design a 4-bit “Absolute-value Detector” with the minimum energy and worst-case delay of 1.25 ns. Here “delay” refers to the worst-case propagation delay and “energy” refers to total energy drawn from VDD given a specified input probability distribution. You may use gate sizing and supply voltage scaling as variables. No registers (i.e. pipelining) are allowed in the design of this project. Work in a group of 2 students.

《操作系统 I 课程设计》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS130P
课程名称:	操作系统 I 课程设计	英文名称:	Operating Systems Project
学 分:	2	学 时:	96
授课对象:		授课语言:	中英文
先修课程:	操作系统 I		

二、课程简介和教学目的

该课程为操作系统 I 的辅助课程设计，主要利用 DiskSim 磁盘仿真工具，通过阅读顶级会议论文 PARAID: A Gear-Shifting Power Aware RAID，实现 5 磁盘 PARAID-5 磁盘阵列并完成相应测试和报告撰写。
如果能额外完成以下工作，有额外 35%加分：
1. 在 DiskSim 中添加 Power Management Module（20% Bonus）
2. Final Report 详尽具体，符合 Technique Paper 的要求（15% Bonus）

三、教学内容、教学方式和学时安排

由于该课程设计内容涉及到论文阅读，DiskSim 源代码阅读、代码修改、实验实现、数据收集，以及报告撰写等内容，课程历时四周，进度节奏由学生根据实际情况自行安排。

课程设计要求每组学生不多于 4 人，学生间需要分工协作。

《计算机科技导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI100C
课程名称:	计算机科技导论	英文名称:	Introduction to Computer Science
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This course introduces basic concepts and tools in computer science.

It teaches program languages and how to use these languages to develop applications.

三、教学内容、教学方式和学时安排

* Modern programming languages, e.g., Python and Rust

* Programming environment, e.g., Linux, revision control, debugging

* Application development, e.g., robotics applications

《数值分析》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI211
课程名称:	数值分析	英文名称:	Numerical Analysis
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The course “Numerical Analysis” provides an overview of basic numerical methods and algorithms covering the representation of numbers and arithmetic operations in a computer, error analysis for simple computer arithmetics, interpolation and regression, orthogonal polynomials and quadrature formulas, linear and nonlinear equation systems including direct and iterative methods as well as basic optimization algorithms. The course is highly recommended for all students in the field of engineering, mathematics, physics, and computer science, who want to work with computer algorithms and engineering software. A deep background in numerical analysis is the basis for many research directions including simulation and computer analysis of dynamic processes, optimization and control, identification and estimation, computer vision, signal processing, as well as network algorithms and communication.

三、教学内容、教学方式和学时安排

The course “Numerical Analysis” consists of 48h of lectures and class exercises in to tal. Topics covered in the course are:

1. Computer representation of numbers and rounding errors
2. Conditioning of arithmetic operations
3. Stability of numerical algorithms
4. Polynomial Interpolation
5. Extrapolation Methods and Limits
6. Splines
7. Trigonometric Approximation and Fast Fourier Transforms (FFT)
8. Orthogonal Polynomials
9. Numerical Integration and Quadrature Formulas
10. Linear Equation Systems and Error Analysis
11. Linear Elimination Methods including Gauss-Elimination
12. Structured Linear Equation Systems and Sparsity
13. Least Squares Optimization
14. Nonlinear Equations Systems and Newton's Method
15. Convergence Analysis of Newton's Method
16. Gauss-Newton Methods
17. Low-Rank Matrix Updates
18. Sequential Quadratic Programming

All lectures are accompanied by pencil & paper as well as computer exercises. A “cr ash-course” on the computer language JULIA will be provided.

《基础信息论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE142
课程名称:	基础信息论	英文名称:	Fundamentals of Information Theory
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

Information theory studies the quantification, storage, and communic ation of information. Applications of fundamental topics of informat ion theory include lossless data compression (e.g. ZIP files), lossy data compression (e.g. MP3s and JPEGs), and channel coding (e.g. LD PC, Turbo code). This course covers the fundamental system aspects o f information theory. The purpose of this course is to understand th

e basics of information theory. The course content includes, but is not limited to, entropy, mutual information, data compression, chan nel capacity, Gaussian channel and multi-user information theory. Th is course requires knowledge of theorem-proof exposition and probabi lity theory.

三、教学内容、教学方式和学时安排

Class week	Topic	Requirements
1-2	1. Introduction, discrete source coding	
3-6	2. Entropy, Relative Entropy, and Mutual Information 2.1 Entropy 2.2 Joint Entropy and Conditional Entropy 2.3 Relative Entropy and Mutual Information 2.4 Relationship Between Entropy and Mutual Information 2.5 Chain Rules for Entropy, Relative Entropy, and Mutual Information 2.6 Jensen's Inequality and Its Consequences 2.7 Log Sum Inequality and Its Applications 2.8 Data-Processing Inequality 2.9 Sufficient Statistics 2.10 Fano's Inequality	
7	3. Entropy Rates of a Stochastic Process 3.1 Markov Chains 3.2 Entropy Rate	
8-9	4. Data Compression 4.1 Examples of Codes	Mid-term

	4.2 Kraft Inequality 4.3 Optimal Codes 4.4 Bounds on the Optimal Code Length 4.5 Kraft Inequality for Uniquely Decodable Codes 4.6 Huffman Codes	
10-13	5. Channel Capacity 5.1 Examples of Channel Capacity 5.2 Symmetric Channels 5.3 Properties of Channel Capacity 5.4 Channel Coding Theorem 5.5 Hamming Codes 5.6 Feedback Capacity 5.7 Source-Channel Separation Theorem	
14-15	6. Gaussian Channel 6.1 Definitions 6.2 Bandlimited Channels 6.3 Parallel Gaussian Channels 6.4 Channels with Colored Gaussian Noise 6.5 Gaussian Channels with Feedback	
16	7. Network Information Theory 7.1 Definition 7.2 Cutset-bound	Final exam

《半导体器件物理》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE220
课程名称:	半导体器件物理	英文名称:	Physics of Semiconductor Devices
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程前 5 周，将从量子力学和统计力学的基本概念出发，去理解半导体中电流特性。在接下来的 7-9 周，各种常见半导体器件的基本工作原理将会被深入介绍，包括 PN 结，PIN 结，肖特基结，BJT，HBT，MOSFET 等半导体器件。

三、教学内容、教学方式和学时安排

周	内容
1	背景与简介
2	量子力学和能带
3	态密度和费米-狄拉克分布
4	半导体基础-I
5	半导体基础-II
6	PN 结
7	PN 结和肖特基结
8	复习和期中考试
9	BJT 简介
10	更多 BJT 的介绍
11	HBT
12	MOS 电容
13	MOSFET
14	高级课题
15	课程报告
16	课程报告与期末考试

《可重构计算》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE216
课程名称:	可重构计算	英文名称:	Reconfigurable Computing
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

The goal of this module is to understand, analyze and research on the architectures, algorithms and applications in the reconfigurable computing. We will introduce the background and recent developments in the field of reconfigurable computing by discussing representative papers from leading journal and conference proceedings. We will introduce the various types of reconfigurable architectures and focus on the most popular fine-grained field programmable gate array (FPGA) architectures from the leading FPGA companies Xilinx and Altera. We will also introduce the electronic design automation algorithms and tools to enable applications to be mapped to FPGAs, and discuss creative applications of FPGAs in different domains.

三、教学内容、教学方式和学时安排

At the end of this course, the student will have acquired:
Awareness of the background and recent developments in the reconfigurable computing field,
The ability to develop and analyze new reconfigurable architectures,
The ability to propose and evaluate new electronic design automation algorithms for reconfigurable architectures,
The ability to creatively apply FPGAs to their domain specific applications.

Part 1: Reconfigurable Architectures
This part helps students to understand what reconfigurable architectures are and how they are differentiated. Topics include simple programmable logic devices, complex programmable logic devices, field programmable gate arrays and coarse grained reconfigurable devices.
Part 2: Design Tools and Methodology
This part focuses on the design tools and methodologies for the reconfigurable computing system. Topics include behavioural synthesis which translates the high level hardware description from algorithms to the register transfer level design, logic synthesis which translates the register transfer level description into the look-up table level description, and physical synthesis which translates the look-up table level description into FPGA bitstreams.
Part 3: Dynamic Reconfiguration
This part focuses on the dynamic reconfiguration. Topics include architecture abstraction, online temporal placement, online communication, and partial reconfiguration.
Part 4: Design Applications
This part introduces reconfigurable computing applications. Applications will focus on the pattern matching, video streaming, distributed arithmetic, adaptive controller, adaptive cryptographic systems, software defined radio and high performance computing. Includes invited talks from industry practitioners who will introduce the design

methodologies and tools that they have used for reconfigurable computing in industry.

《光通信系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE244
课程名称:	光通信系统	英文名称:	Optical Communication Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

光通信系统》旨在讲解光通信系统当中的各重要组件及模块，包括光纤，光发射机，光检测器，光放大器等。课程将着重于讲解各组件的物理机制及其在光通信系统中的应用。此外，课程还将讲解光通信系统的设计及如何评价光通信系统的性能。

三、教学内容、教学方式和学时安排

星期	模块	内容
1	导论	光通信系统简介
2-4	光纤	1. 几何光学 2. 波的传播 3. 光纤中的色散 4. 光纤中的损耗 5. 光纤中的非线性影响
5-8	光发射机	1. 发光二极管 2. 半导体激光器 3. 激光器工作特性 4. 光信号的产生 5. 光发射机的设计
9-11	光接收机	1. 光电探测器 2. 光接收机的设计 3. 光接收机的噪声分析 4. 光接收机的灵敏度 5. 灵敏度的衰减

12-14	光放大器	1. 半导体光放大器 2. 拉曼放大器 3. 掺铒光纤放大器
15-16	光波系统	1. 系统框架 2. 设计考量 3. 多通道系统

《导波光学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290C
课程名称:	导波光学	英文名称:	Guided Wave Optics
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程将介绍集成光学与光纤光学中光的传播特性，以及一些相关的基本概念。我们涵盖的内容不仅有光在介质波导和光纤中的传输特性，也包括定向耦合器，导波光栅，阵列波导光栅和光纤偏振成分的基本工作原理。设置这门课的目标是让大家熟悉集成光学及光纤光学这一正在蓬勃发展的领域中的一些基本概念和相关技术

三、教学内容、教学方式和学时安排

采用中英文授课的方式，教材、课件、作业和报告都采用英文

1. 电磁场理论和导波理论回顾

2. 阶梯型薄膜波导

3. 薄膜波导中的传输损耗

4. 矩形边界的三围波导

5. 光定向耦合器及其应用

6. 层状介质中的波传输

7. 导波光栅

8. 阵列波导光栅

9. 阶梯型光纤中的传输特性

10. 弱导阶梯型光纤中的传输特性

11. 单模光纤中的双折射

12. 单模光纤中的脉冲波传输

《偏微分方程数值解》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI214H
课程名称:	偏微分方程数值解	英文名称:	Numerical Methods for PDEs
学 分:	3	学 时:	48
授课对象:		授课语言:	中英文
先修课程:	数值分析		

二、课程简介和教学目的

作为数学工具，偏微分方程在数学学科与其它科学技术领域都有着广泛的应用。在已掌握本科阶段高等数学与线性代数知识的基础上，学生通过本课程的学习可以进一步深化求解偏微分方程的相关知识，培养抽象思维能力、科学计算能力、科学研究能力，从而提高解决实际问题的能力。

三、教学内容、教学方式和学时安排

本课程主要讲授以下内容:

1. Parabolic equations in one space variable (8 Lectures)

2. 2D parabolic equations (8 Lectures)

3. Hyperbolic equations in one space variable (8 Lectures)

4. Elliptic equations (8 Lectures)

5. Iterative methods (8 Lectures)

6. Advanced methods and research topics (8 Lectures)

《太赫兹光电子学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE290D
课程名称:	太赫兹光电子学	英文名称:	Terahertz Opto-electronics
学 分:	2	学 时:	32
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

太赫兹(THz)科学与技术是一个应用前景广泛、发展极其迅速的交叉学科前沿领域。THz 波具有不同于微波、红外光以及 X 射线的特点，其研究与应用涉及到物理学、材料科学、生命科学、天文学、信息技术和国防安全等多个领域。THz 波在物体成像、环境监测、医疗诊断、射电天文、宽带移动通讯、卫星通信和军用雷达等方面具有重大的科学价值和广阔的应用前景。现代电子学和光子学技术的发展，为 THz 科学研究与技术开发起了极大的推动作用。THz 科学与技术的研究热潮目前正处于一个方兴未艾的上升时期。现在已经有从大学和科研院所分离出来的从事 THz 器件生产和 THz 应用系统开发的公司，它们的出现标志着 THz 技术从实验室走向商业，从学术研究走向应用。
本课程主要对半导体 THz 辐射源与探测器的基本原理、模拟与设计、器件研制方法以及 THz 通信与成像应用等，做了比较系统的阐述。

三、教学内容、教学方式和学时安排

课堂教学内容	教学进度和学时安排	教学方式
太赫兹波产生、探测与应用概述	4	授课
太赫兹场与低维半导体的相互作用及高场电子输运	4	授课与习题
电子学太赫兹振荡器与器件模拟	4	授课与习题
太赫兹半导体量子级联激光器	8	授课与实验
太赫兹半导体量子阱探测器	4	授课与实验

太赫兹通信	4	**授课与实验**
太赫兹成像	4	**授课与实验**

《无线与移动系统》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS222
课程名称:	无线与移动系统	英文名称:	Wireless and Mobile Systems
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

智能手机，可穿戴设备，VR 眼镜，航拍无人机，物联网传感器等各种各样的移动和无线设备在现代生活中越来越流行。本课程旨在向学生介绍这些设备中无线通信和移动应用的设计方式及尚待解决的问题。课程的教学内容基于该领域中最新的研究论文，涵盖包括通信协议，信号处理算法以及应用设计中较为深入的内容。课程内容以实际系统设计为导向，并着重于分析在设计和实现这些系统过程的实际问题和解决方法。同时，学生可以通过课程项目设计和实现一个无线通信或者移动系统，实践课程所学。

三、教学内容、教学方式和学时安排

	授课内容		授课内容
1	课程介绍	2	无线通信基础
3	OFDM 介绍 1	4	OFDM 介绍 2
5	无线网 MAC 层 1	6	无线网 MAC 层 2
7	MIMO 介绍 1	8	MIMO 介绍 2
9	软件无线电系统	10	Backscatter 通信 1
11	Backscatter 通信系统 2	12	可见光通信
13	声音通信	14	电磁干扰通信
15	无线定位系统 1	16	讨论课 1：拟定课程项目
17	无线定位系统 2	18	讨论课 2：拟定课程项目
19	震动通信	20	其他新兴通信方式
21	无线传感系统 1	22	无线传感系统 2

23	无线充电	24	体域网
25	毫米波系统	26	数据中心网络中的无线通信
27	无线网络编码	28	无线网络安全
29	干扰消除技术	30	全双工通信系统
31	课程项目答辩 1	32	课程项目答辩 2

《计算机体系结构 III》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS210
课程名称:	计算机体系结构 III	英文名称:	Computer Architecture III
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本研究生课程主要讨论计算机系统结构领域的进阶内容。为了能够顺利完成该课程的学习，选修该课程的学生需要具有基本的计算机组成与系统结构或操作系统方面的知识。该课程采用课堂教学、实验、论文阅读和报告陈述相结合的方式，旨在让学生善用计算机系统结构设计方面的实用知识和基本规则。学生的考核主要通过考勤、实验、论文报告陈述以及学期科技论文等几个方面完成。其中科技报告由书面报告和口头陈述两部分组成，要求学生协作完成。

三、教学内容、教学方式和学时安排

Week	Content
Week 1A	Lecture: Kickoff / Introduction
Week 1B	Lecture: Computer Hierarchy: Cache I Training Seminar: How to read technical papers
Week 2A	Lecture: Computer Hierarchy: Cache II Training Seminar: How to write technical papers
Week 2B	Lecture: Computer Hierarchy: Cache III Discussion: Cache
Week 3A	Lecture: Computer Hierarchy: Memory I
Week 3B	Lecture: Computer Hierarchy: Memory II

Week 4A	Lecture: Computer Hierarchy: Memory III Discussion: Memory
Week 4B	Lecture: Computer Hierarchy: Storage I
Week 5A	Lecture: Computer Hierarchy: Storage II Presentation 1 Proposal Part 1/2
Week 5B	Lecture: Computer Hierarchy: Storage III Discussion: Storage Presentation 2 Proposal Part 2/2
Week 6A	Lecture: Modeling and Evaluation I Presentation 3
Week 6B	Lecture: Modeling and Evaluation II Presentation 3
Week 7A	Lecture: Modeling and Evaluation III Discussion: Modeling and Evaluation Presentation 4
Week 7B	Lecture: High Performance Computing Systems I Presentation 5
Week 8A	Lecture: High Performance Computing Systems II Presentation 6
Week 8B	High Performance Computing Systems III Discussion: HPC Presentation 7
Week 9A	Big Data & Cloud Computing I Presentation 8 Progress Report Part 1/2
Week 9B	Big Data & Cloud Computing II Presentation 9 Progress Report Part 2/2
Week 10A	Big Data & Cloud Computing III Discussion: Big Data & Cloud Presentation 10
Week 10B	Presentation 11 Presentation 12
Week 11A	Final Presentation Part 1/4
Week 11B	Final Presentation Part 2/4
Week 12A	Final Presentation Part 3/4
Week 12B	Final Presentation Part 4/4

《计算影像学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS276
课程名称:	计算影像学	英文名称:	Computational Photography
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

Research breakthroughs in 2D image analysis/synthesis, coupled with the growth of digital photography, have provided a practical and artistic medium for creating astonishing special effects in feature movies and computer games. This project/topics course gives a broad overview on modern computational approaches to generating digital images and videos.

This course is a convergence between computer vision, computer graphics, image processing, and photography. It will discuss in-depth a broad range of topics in digital photography and videos, including video capturing devices, novel camera models, non-traditional lighting and shading techniques, high dynamic range (HDR) vs. low dynamic range (LDR) images/videos, as well as many post-processing algorithms for generating context-rich images and videos.

三、教学内容、教学方式和学时安排

- Week 1: Introduction and motivating examples (movie special effects, robotics, medical imaging, etc)
- Week 2: Cameras Part I: Lens, Aperture, Focus.
- Week 3: Camera Part II: Shutter, Sensors, Flash.
- Week 4: Light Fields Modeling, Rendering, and Imaging.
- Week 5: Signal Processing and Frequency Domain Light Field Analysis.
- Week 6: Poisson Image Editing.
- Week 7: Graph-cut and Its Applications.
- Week 8: High Dynamic Range Imaging.
- Week 9: Bilateral Filters and Applications.
- Week 10: Image Matting.
- Week 11: Motion Blurs and Deblurs.
- Week 12: Next-Generation Cameras.
- Week 13: Course project presentations

《随机过程》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI241
课程名称:	随机过程	英文名称:	Probability and Stochastic Processes

学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程介绍随机过程的理论及其应用，主要内容包括概率论回顾，鞅，泊松过程，更新过程，马尔科夫链，排队过程。教学目的是让学生系统的掌握分析随机模型以及设计随机算法的常用方法，并能够熟练运用这些方法去解决通信，网络，信号处理，机器学习等领域的相关实际问题。

三、教学内容、教学方式和学时安排

每周 4 个学时，共 16 周，教学方式以授课为主。 具体的教学安排如下：

1. 概率论回顾以及概率论不等式
2. 条件概率以及鞅
3. 泊松过程
4. 更新过程
5. 离散时间马尔科夫链
6. 连续时间马尔科夫链
7. 排队过程

《即时定位与地图构建》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS284
课程名称:	即时定位与地图构建	英文名称:	Simultaneous Localization and Mapping
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

The course provides an introduction into the topic of Simultaneous Localization and Mapping, in short “SLAM”. As its name reveals, SLAM describes the problem of continuously localizing an agent with sensors in an unknown environment while simultaneously establishing a 2

D or 3D map of this environment. This problem lies at the heart of many important emerging applications, such as AR/VR (smart phone/headset localization and perception of environment geometry for virtual content insertion), autonomous driving (real-time vehicle localization and 3D road-scene perception), and of course robotics. The course focusses on visual SLAM, which has undergone particularly vibrant development over the past decade.

三、教学内容、教学方式和学时安排

The course is open to all graduate students and 3rd and 4th year undergraduate students. The following is a tentative list of covered topics:

-Applications of SLAM

-Homogeneous coordinate transformations and representations of spatial orientations

-Sensors, Markov localization

-2D SLAM: Particle filter

-3D SLAM: Iterative Closest point

-Visual SLAM:

* The geometry of a single view/a pair of views

* Feature extraction, tracking, and matching

* Visual odometry

* EKF SLAM vs. Parallel Tracking and Mapping

* Dense Tracking and Mapping, RGBD-SLAM

* Map representations (sparse, dense, semi-dense)

* Pose-only SLAM, Graph SLAM

* Place recognition and loop closure

* Dynamic and multi-body SLAM

-Sensor fusion:

* SLAM with stereo and multi-perspective cameras

* Visual-inertial SLAM

Besides the lectures, the course will also involve homework exercises and a project.

The homework exercises will mostly involve C++ implementations of sub-modules of SLAM, and useful open-source material and suggestions regarding the C++ development environment will be provided to the students. The exercises will be introduced during the lectures as well as posted on the course webpage (dates and deadlines will be introduced in the introduction lecture).

A project will make up for a significant part of the course. A selection of possible project topics will be presented at the beginning of the course, but students are also welcome to submit their own proposals (new proposals will have to be discussed with the convener before they can be accepted). The projects will involve the implementation of an end-to-end pipeline for solving a SLAM problem for a particular configuration of sensor type, motion and environment. Depending on the class size, the project and all its related aspects might be done in small groups (up to three students).

Since this is an entirely new course, a detailed teaching schedule is not yet available. However, the general idea is that the beginning of the course will be more heavy on lectures and homeworks, which would leave more space towards the end of the semester to allow for a successful completion of the project.

《深度学习》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS280
课程名称:	深度学习	英文名称:	Deep Learning
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:	优化与机器学习		

二、课程简介和教学目的

In the past few years, deep neural networks (DNNs) emerged as a family of computational models in machine learning that have demonstrated tremendous empirical successes in representing and learning comple

x but structured information from massive data. Such data include bu t not limited to speeches, natural languages, and images, and the su ccesses have made DNNs a powerful and popular tool in a wide range o f applications such as speech recognition, NLP, and computer vision. This course aims to provide a basic but comprehensive introduction to deep neural networks, including basic model families (CNNs and RN Ns etc.), their training methods, implementation issues, and exempla ry applications in the above domains. Through the courses, the stude nts will be required to learn how to use and implement various neura l networks, as well as how to train and optimize the networks' para meters for various data and tasks. More importantly, the course will also focus on some of the theoretical and optimization aspects of D NNs so that the students will gain better conceptual and theoretical understanding of DNNs, both their capabilities and limitations.

三、教学内容、教学方式和学时安排

As the course subject is still an open, dynamic, fast evolving research area, there is n o fixed syllabus for this course. The main prerequisites are similar to the Stanford CS 231n "Convolutional Neural Networks for Visual Recognition" (which has a MOOC -based course), and the first part of the course will follow a similar line of developme nt. We will augment the course with an additional project on NLP and some new rec ent results and developments in models, theory, algorithms and applications of DNN s. Later parts of the course might have some invited lectures by domain experts.

Aside from the two lectures per week, there will be a weekly discussion session led b y the TAs or the Instructors.

1. Programming and Background Knowledge (Week 1-3, Head TAs and Xuming He)

Basic Tools: Python 2.7 /Numpy, IPython Notebook Tutorial

Advanced Tools: AWS, Minpy, Mxnet, Caffe, Theano, TensorFlow, PyTorch

Linear Algebra, Statistics, and Machine Learning Basics (NN, Linear Classifiers etc)

Assigned Project 1 (Linear Classifier, 2-layer NN)

2. Basic Neural Networks (Week 4-5, Xuming He)

Model Architectures, Training and Optimization Techniques.

Assigned Project 2 (Neural Networks)

Course Project Proposal Due

3. Convolutional Neural Networks (Week 6-8, Xuming He)

Model Architectures, Training and Optimization Techniques

Computer Vision and Applications in Object Detection and Recognition

Assigned Project 3 (ConvNets with Applications in Vision)

4. Recurrent Neural Networks and LSTM (Week 9-10, Xuming He)

Model Architectures, Training and Optimization Techniques

Language Models and Applications in NLP

Assigned Project 4 (RNN with Applications in NLP)

5. Advanced and Selected Topics (Week 11 and on, Guest Lecturers and Xuming He)

Deep Generative Models for Image Synthesis

Deep Reinforcemnet Learning for Game and Control

Systems and Advanced Platforms: Mxnet/Caffe/Torch/Theano/TensorFlow/

Theory: Deep Learning from Optimization Perspective

i. Instance-Specific Optimization (Unfolding, Variational Perspective)

ii. Optimality Conditions of Learning DNNs

iii. Understanding Convolutional/Deconvolutional Neural Networks

Relationships to Other Aspects of Machine Intelligence or to Human Intelligenc e

i. Reconciliation among Data-driven, Model-driven, and Principle-driven

ii. Design Principles of DNNs from Systems Theory (adaptive Kalman filter, error correction/residual networks, feedback, receding horizon etc.)

iii. Inspirations from Neuroscience for new computing models or mechanisms

iv. Evolution of AI models, methods, and methodologies.

《计算机视觉 II》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS272
课程名称:	计算机视觉 II	英文名称:	Computer Vision II
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

This course will cover the recent advances of computer vision tasks.

三、教学内容、教学方式和学时安排

1. The overall picture of object recognition (0.5 week)

Line 1: From computer vision perspective:

Take image understanding as an example and discuss the state-of-the-art technology for computer vision, and extend it to videos. This course will cover the following 6 parts, including:

Saliency detection (unsupervised saliency detection/salient object discovery) segmentation (unsupervised image segmentation) object detection (face detection/general object detection, supervised methods) object recognition (face recognition/general image classification, supervised methods) object identification ((unsupervised) content based image retrieval/(supervised)face verification)video processing (tracking/event classification(supervised))

Line 2: From machine learning perspective

Machine learning: unsupervised learning methods to supervised learning methods. For unsupervised methods, it will cover clustering methods, sparse representation, low-rank, etc. For supervised methods, it will cover SVM/Softmax/CNN

2: Saliency detection (1 week)

2.1 Definition of saliency map/salient object discovery and a survey of image saliency detection.

2.2 Saliency detection techniques.

Top-down methods and bottom-up methods

2.3 Application of saliency detection:

Content-based image resizing, object proposals for object detection

3: Image segmentation (1.5 weeks).

3.1 Definition of image segmentation and survey of image segmentation.

3.2 Some representative image segmentation methods: graph cuts, Minimum description length, Active contour model.

3.3 Image co-segmentation

4: object detection (2 weeks)

4.1 A survey of face detection.

4.2 Some representative face detection methods

SVM

Boosting

Deformable Part Based Model.

4.2 General object detection

5: Object recognition (4 weeks)

5.1 face recognition (2 weeks)

Subspace based method

Sparse representation based method

DNN based method

5.2 general object recognition(2weeks)

Conventional image representation

Deep neural networks based image representation

6: Object Identification (2weeks)

6.1 Face verification

6.2 CBIR

Hashing

7 Video processing(2 weeks)

7.1 tracking

7.2 motion representation

7.3 video representation

Spatial -temporal features for video representation

Deep neural networks based feature for video representation.

7.4 video classification

《算法博弈导论》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	CS243
课程名称:	算法博弈导论	英文名称:	Introduction to Algorithmic Game Theory
学 分:	4	学 时:	64
授课对象:		授课语言:	中英文

先修课程:	

二、课程简介和教学目的

Over the past fifteen years, research in theoretical computer science, artificial intelligence, and microeconomics has joined forces to tackle problems involving incentives and computation. This research field, commonly named Algorithmic Game Theory, is becoming increasingly more relevant due to the prominence of the Internet as the computing platform. The research in algorithmic game theory is rooted in and has applications for a number of different academic disciplines such as computer science, math and economics. This course will introduce the foundation of algorithmic game theory and discusses its broad applications such as auctions, president elections, matching, crowdsourcing and peer predication.

三、教学内容、教学方式和学时安排

1. Game Theory Introduction
    1. Game Play: Nash equilibrium, dominant strategies, mixed strategies etc.
    2. Game Design: auctions, president election, crowdsourcing etc.
2. Auctions
    1. Second Price Auction (eBay auctions, Shanghai car plate auctions)
    2. Internet Advertising (Google, Baidu)
    3. Combinatorial Auction (spectrum auction)
3. Social Choice
    1. President Election (winner determination)
    2. Ranking (preference aggregation)
4. Matching Markets
    1. Student-School Matching (college entrance examination/高考)
    2. Kidney Exchange (器官捐献)
5. Human Computation
    1. Crowdsourcing (image labeling)
    2. Peer Prediction (who is going to win the next world cup?)
6. Exchange Markets
    1. Double Auction (stock exchanges)
    2. Online Auction
    3. The Sharing Economy Markets (car-sharing, house-sharing/Airbnb)

《高级几何学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	SI112
课程名称:	高级几何学	英文名称:	Advanced Geometry
学 分:	4	学 时:	64
授课对象:		授课语言:	英语
先修课程:			

二、课程简介和教学目的

This is an advanced undergraduate course designed for students who want to strengthen their mathematical background. As such, the only prerequisite is linear algebra. The focus of the course is geometry, in particular the study of convex and algebraic sets. Such sets arise frequently in applications (e.g. Machine Learning, Data Science, Control Systems, e.t.c.), since 1) minimization of convex functions over convex sets is an ideal situation, yet 2) very often the parameters of many problems satisfy non-linear/non-convex relations. The aim of this course is to offer an introduction to the basic properties of convex spaces (convex geometry) and algebraic spaces (algebraic geometry) as well as train the students in rigorous mathematical thinking. Some applications in unsupervised machine learning will be discussed.

三、教学内容、教学方式和学时安排

Topology: Metric spaces; Topological spaces; Connectedness; Compactness.

Convex Geometry: Algebraic, combinatorial and topological properties of convex sets; Supporting and separating hyperplanes; Extremal representations; Polyhedral theory; Convex functions.

Algebraic Geometry: Elements of commutative ring theory; Affine and projective varieties; Groebner basis.

《物理光学》

一、课程基本信息

开课单位:	信息科学与技术学院	课程代码:	EE131
课程名称:	物理光学	英文名称:	Physical Optics

学 分:	4	学 时:	64
授课对象:		授课语言:	中英文
先修课程:			

二、课程简介和教学目的

本课程将从光的波动本质出发来介绍光的性质，包括光的偏振特性，干涉特性，和衍射特性，并从物理光学的角度来解释光学成像系统中的解析度极限问题。在本课程中，我们将采用物理光学来对光学的基本定理和基本现象进行讨论。

三、教学内容、教学方式和学时安排

1. 光的传输

-光的本质, 光的速度

2. 光的矢量本质

-能量的流动, 坡印廷矢量, 光的偏振特性, 琼斯矩阵, 光的反射与折射, 菲涅尔公式, 布鲁斯特角

3. 光的相干性和干涉性

-线性叠加, 迈克逊干涉仪, 相干时间与相干长度, 强度干涉, 傅里叶变换光谱学

4. 多光束干涉

-多光束间的干涉, 法布里-珀罗干涉仪, 多层薄膜理论

5. 光的衍射

-夫琅和费和菲涅尔衍射, 傅里叶变换在衍射中的应用, 通过全息衍射实现波前的重建

6. 光与固体物质的相互作用

-麦克斯韦方程组和宏观场, 波动方程, 色散, 光在各项同性介质/导体/晶体中的传输, 固体中的法拉第旋转, 磁光和电光效应, 非 线性光学